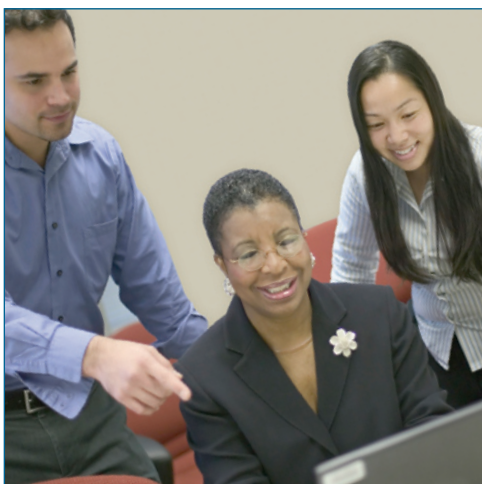
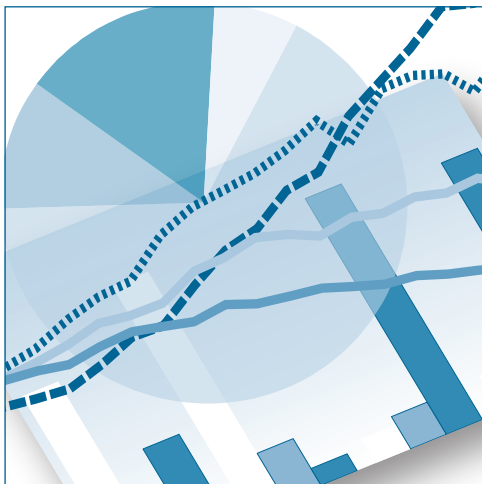


# Wisconsin Diabetes Surveillance Report 2005



Wisconsin Diabetes Prevention and Control Program

**Wisconsin Diabetes Prevention and Control Program  
Bureau of Community Health Promotion  
Division of Public Health  
Department of Health and Family Services**

For information about this surveillance report contact:

**Jenny Camponeschi, MS, Epidemiologist  
Wisconsin Diabetes Prevention and Control Program  
Bureau of Community Health Promotion  
PO Box 2659  
Madison, WI 53701-2659  
Phone: (608) 267-1449  
Fax: (608) 266-8925  
Email: [campoj1@dhfs.state.wi.us](mailto:campoj1@dhfs.state.wi.us)**

**Visit our website at: <http://dhfs.wisconsin.gov/health/diabetes/>  
PPH 43084 (10/05)**

This publication was supported by Cooperative Agreement Number U32/CCU522717-03 from the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not represent the official views of the CDC.

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Suggested citation:

Department of Health and Family Services, Division of Public Health, Diabetes Prevention and Control Program. Wisconsin Diabetes Surveillance Report, 2005. October 2005.

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# Executive Summary

The Wisconsin Diabetes Prevention and Control Program is funded by the Centers for Disease Control and Prevention to reduce and prevent the burden of diabetes in Wisconsin.

## Significant findings

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- It is estimated that over 235,000 adults in Wisconsin have been diagnosed with diabetes and an additional 94,000 adults are estimated to have diabetes that has not yet been diagnosed.
- An estimated 4,000 children and adolescents have been diagnosed with diabetes.
- The 1988-1994 National Health and Nutrition Examination Survey (NHANES) found that 40.1% of adults aged 40-74 years have pre-diabetes. This translates into an estimated 835,810 Wisconsin adults aged 40-74.
- Eighty-five percent of adults with diabetes are overweight or obese, compared to 57% of adults without diabetes.
- The percentage of adults with diabetes who are obese (body mass index  $\geq 30.0$  kg/m<sup>2</sup>) has increased from 30% in 1995-1996 to 49% in 2001-2002.
- Thirty-nine percent of adults with diabetes self-reported their general health status as “fair” or “poor,” compared to only 10% of adults without diabetes.
- Wisconsin has surpassed the Healthy People 2010 goal for A1C testing and is close to meeting the Healthy People 2010 goals for dilated retinal eye exam, foot exam, and dental visit.
- There were 6,753 hospitalizations in 2002 where diabetes was listed as the principal diagnosis. In the same year, there were 85,133 hospitalizations where diabetes was listed as any diagnosis; this accounts for 13.5% of all Wisconsin hospitalizations.
- In 2002, there were \$1.35 billion in diabetes-related hospitalization charges for Wisconsin residents; this accounts for 16.6% of all hospitalization charges.
- In 2002, there were 1,433 non-traumatic lower-extremity amputations performed when diabetes was listed as any diagnosis.
- The male rate for non-traumatic lower-extremity amputations is two times the rate for females.
- The rates for end-stage renal disease (ESRD) prevalence and incidence have steadily increased from 1978 to 2002; however, currently the Wisconsin prevalence and incidence rates are lower than the rates for the United States.
- In 2003, there were 1,326 deaths where diabetes was listed as an underlying cause of death. This number is likely an underestimate, as diabetes often contributes to a death for which another disease/condition is listed as the underlying cause of death.

# Introduction

Diabetes is a serious, common, costly, yet controllable disease affecting over 329,000 adults and 4,000 children and adolescents in Wisconsin.<sup>1</sup> Diabetes is a metabolic disorder characterized by high blood glucose levels resulting from defects in insulin production, action, or both. Type 1 diabetes occurs when the body's immune system destroys the cells in the pancreas that produce insulin, leading to a lack of insulin. People with Type 1 diabetes must take insulin to survive. Type 2 diabetes usually begins with insulin resistance, a condition in which the cells in the body do not use insulin properly. There are several risk factors associated with Type 2 diabetes, including overweight or obesity and physical inactivity. Type 2 diabetes can be controlled with diet and exercise, medications, and/or insulin, depending on the progression of the disease. Gestational diabetes is a form of diabetes that is diagnosed in some women during pregnancy; it occurs in approximately 4% of all pregnancies.<sup>2</sup> Other types of diabetes occur, but they are less common.

People with diabetes are at increased risk of diabetes-related complications, including blindness, kidney disease, foot and leg amputations, cardiovascular disease, stroke, depression, poor oral health, and death from influenza and pneumonia. Many of these complications may be prevented, delayed, and/or progression slowed, by optimizing glycemic control and providing ongoing preventive care to include early identification of problems, intervention, and treatment.<sup>3</sup>

Besides serious health-related complications, diabetes is also economically costly in Wisconsin. The direct (medical care) and indirect (lost productivity) costs of diabetes in Wisconsin total an estimated \$4.52 billion. Approximately \$3.12 billion are direct medical expenditures for adults, \$1.35 billion are from indirect costs for adults, and an estimated \$53 million are direct medical expenditures for children and adolescents. For this analysis, an estimate of indirect costs for children and adolescents is not included, as they are generally not members of the workforce. Note that this estimate only includes persons diagnosed with diabetes.<sup>4</sup>

Access to meaningful and important information is a critical requirement for any public health system. It is essential to be familiar with data related to diabetes, its management, and complications in order to make improvements in the care of those with and at risk of diabetes, as well as the entire community. Data and information are necessary in directing diabetes-related initiatives, because they provide information on where a community/system has been and where they need to go to accomplish their goal to provide the best care for people with and at risk for diabetes.

# Estimated Diabetes Prevalence in Adults

Diabetes is becoming increasingly prevalent in the United States and in Wisconsin. There are 18.2 million people in the United States that have diabetes; approximately 5.2 million of these people have diabetes that has not yet been diagnosed.<sup>5</sup>

The Wisconsin Behavioral Risk Factor Survey (BRFS) is used as the main data source for obtaining diabetes prevalence estimates in Wisconsin.<sup>1</sup> The BRFS is a random-digit-dial telephone survey administered to Wisconsin household members 18 years and older to assess the prevalence of risk behaviors and health practices that affect health status.<sup>6</sup> The BRFS includes a core survey, as well as additional optional modules. One of the most important questions in the

core survey for diabetes surveillance is “Have you ever been told by a doctor that you have diabetes?” This provides an estimate of the number of people in Wisconsin that have diabetes.

Further details on the methodology employed to estimate diabetes prevalence are provided in the “Methodology and Limitations” section.

It is estimated that over 235,000 adults in Wisconsin have been diagnosed with diabetes and an additional 94,000 adults are estimated to have diabetes that has not yet been diagnosed.<sup>1</sup> Table 1 provides estimated diagnosed, undiagnosed, and total numbers and percents of adults with diabetes by three separate age groups, as well as the estimate for all ages of adults.

**Table 1: Estimated Prevalence of Diabetes in Wisconsin Adults by Age Group, All Races and Ethnicities.** *Source: The 2005 Burden of Diabetes in Wisconsin*

Age category	Estimated Number Diagnosed [%]		Estimated Number Undiagnosed [%]		Estimated Total number [%]	
Ages 18 – 44	38,410	(1.8%)	15,360	(0.7%)	53,770	(2.5%)
Ages 45 – 64	102,360	(8.0%)	40,950	(3.2%)	143,310	(11.2%)
Ages 65+	94,560	(13.4%)	37,820	(5.4%)	132,380	(18.7%)
All ages adult	235,330	(5.7%)	94,130	(2.3%)	329,460	(8.0%)

Total percent may not equal the sum of diagnosed percent and undiagnosed percent, due to rounding.

**Figure 1: Estimated Total (Diagnosed and Undiagnosed) Percent of Wisconsin Adults with Diabetes by Age Group, All Races and Ethnicities.**

*Source: The 2005 Burden of Diabetes in Wisconsin*

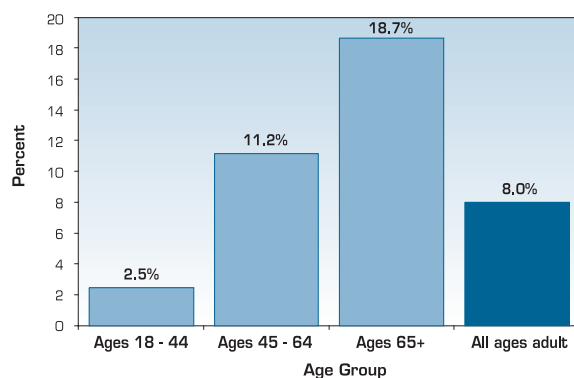
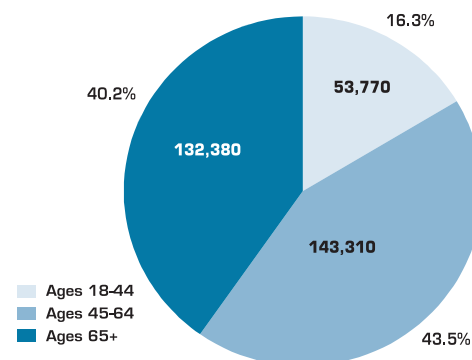


Figure 1 illustrates the prevalence differences by age, while Figure 2 illustrates which age groups adults with diabetes fit into.

**Figure 2: Classification by Age Group of All Estimated Wisconsin Adults with Diagnosed and Undiagnosed Diabetes, All Races and Ethnicities.** *Source: The 2005 Burden of Diabetes in Wisconsin*



Currently, information on the prevalence of diabetes does not distinguish between Type 1 and Type 2 diabetes. However, the Centers for Disease Control and Prevention estimates that 90-95% of diagnosed cases of diabetes are Type 2 diabetes, while 5-10% of diagnosed cases of diabetes are Type 1.<sup>7</sup>

# Estimated Diabetes Prevalence in Adults by County

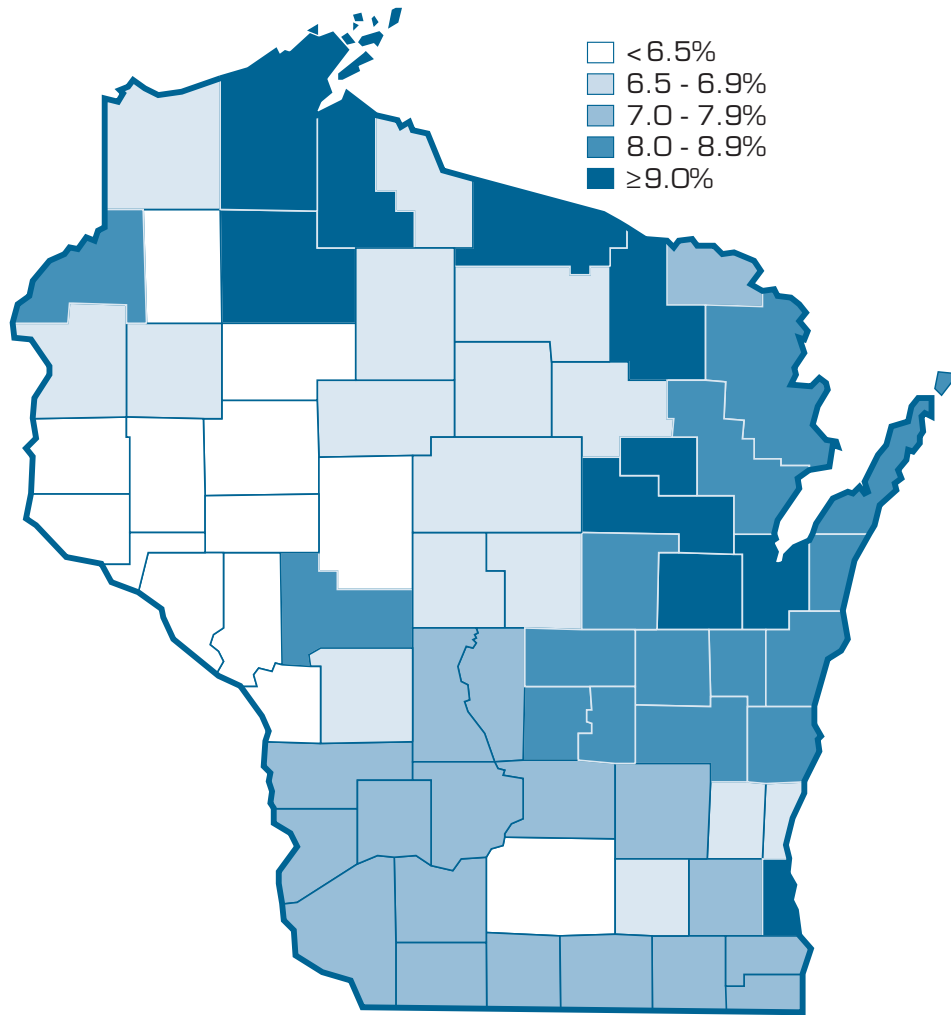


Figure 3: Map of Estimated Total (Diagnosed and Undiagnosed) Prevalence of Diabetes in Wisconsin, Age-adjusted Percent of Adults by County.

Source: *The 2005 Burden of Diabetes in Wisconsin*

# Estimated Diabetes Prevalence in Adults by Race/Ethnicity

Diabetes is more prevalent in certain racial and ethnic populations in Wisconsin. Tables 2 through 7 provide estimates of diagnosed, undiagnosed, and total adults with diabetes by racial/ethnic groups in Wisconsin.<sup>1</sup> Age-specific estimates are presented for three separate age groups.

The highest prevalence in the 18-44 year and 45-64 year age groups is found in the American Indian racial group. For the 18-44 year age group, African Americans have almost double the prevalence (3.9%) than all other racial/ethnic groups, except for American Indians. With the exception of the American Indian racial group, African Americans also have the highest prevalence (20.3%) for the 45-64 year age group, nearly two times the prevalence for Non-Hispanic Whites in the same age group. Hispanic/Latino adults have the highest prevalence (33.0%) for the age group 65 years and above, followed by American Indians (30.5%), Other/multi race (25.7%), African Americans (25.6%), Asian Americans (23.4%), and Non-Hispanic Whites (18.3%).

Estimated overall prevalence (for all ages 18 years and above) is not presented in percent format in Tables 2 through 7, as the population distribution varies greatly for some racial/ethnic groups. Differences in population distribution can lead to misleading overall prevalence estimates. For example, 77.4% of the adult Hispanic/Latino population is aged 18-44 years, compared to 49.2% of the Non-Hispanic White population.<sup>8</sup> Due to this difference in age distribution and the fact that the prevalence of diabetes is lower for younger age groups, the prevalence estimate for the “all ages” group for the Hispanic/Latino population would be underestimated if it were presented in raw percent format. Estimated age-adjusted prevalence rates are provided in Table 8, to allow comparison of overall prevalence rates between racial/ethnic groups.

**Table 2: Estimated Prevalence of Diabetes in Wisconsin African American\* Adults by Age Group.**

*Source: The 2005 Burden of Diabetes in Wisconsin*

Age category	Estimated Number Diagnosed (%)		Estimated Number Undiagnosed (%)		Estimated Total Number (%)	
Ages 18 – 44	3,530	(2.8%)	1,410	(1.1%)	4,940	(3.9%)
Ages 45 – 64	7,460	(14.5%)	2,980	(5.8%)	10,440	(20.3%)
Ages 65+	3,010	(18.3%)	1,200	(7.3%)	4,210	(25.6%)

\* Non-Hispanic

Total percent may not equal the sum of diagnosed percent and undiagnosed percent, due to rounding.

**Table 3: Estimated Prevalence of Diabetes in Wisconsin American Indian/Alaska Native\* Adults by Age Group.** *Source: The 2005 Burden of Diabetes in Wisconsin*

Age category	Estimated Number Diagnosed (%)		Estimated Number Undiagnosed (%)		Estimated Total Number (%)	
Ages 18 – 44	5,350	(27.0%)	2,140	(10.8%)	7,490	(37.8%)
Ages 45 – 64	4,090	(49.0%)	1,640	(19.7%)	5,730	(68.7%)
Ages 65+	530	(21.8%)	210	(8.6%)	740	(30.5%)

\* Non-Hispanic

Total percent may not equal the sum of diagnosed percent and undiagnosed percent, due to rounding.

# Estimated Diabetes Prevalence in Adults by Race/Ethnicity

**Table 4: Estimated Prevalence of Diabetes in Wisconsin Asian American\* Adults by Age Group.**

Source: *The 2005 Burden of Diabetes in Wisconsin*

Age category	Estimated Number Diagnosed [%]		Estimated Number Undiagnosed [%]		Estimated Total Number [%]	
Ages 18 – 44	680	(1.4%)	270	(0.6%)	950	(2.0%)
Ages 45 – 64	1,040	(7.6%)	420	(3.1%)	1,460	(10.7%)
Ages 65+	700	(16.7%)	280	(6.7%)	980	(23.4%)

\* Non-Hispanic

Total percent may not equal the sum of diagnosed percent and undiagnosed percent, due to rounding.

**Table 5: Estimated Prevalence of Diabetes in Wisconsin Hispanic/Latino\* Adults by Age Group.**

Source: *The 2005 Burden of Diabetes in Wisconsin*

Age category	Estimated Number Diagnosed [%]		Estimated Number Undiagnosed [%]		Estimated Total Number [%]	
Ages 18 – 44	1,440	(1.4%)	570	(0.6%)	2,010	(2.0%)
Ages 45 – 64	3,260	(13.7%)	1,310	(5.5%)	4,570	(19.2%)
Ages 65+	1,470	(23.6%)	590	(9.5%)	2,060	(33.0%)

\* Includes all races with Hispanic/Latino Ethnicity

Total percent may not equal the sum of diagnosed percent and undiagnosed percent, due to rounding.

**Table 6: Estimated Prevalence of Diabetes in Wisconsin Other Race/Multi-Race\* Adults by Age Group.** Source: *The 2005 Burden of Diabetes in Wisconsin*

Age category	Estimated Number Diagnosed [%]		Estimated Number Undiagnosed [%]		Estimated Total Number [%]	
Ages 18 – 44	190	(1.1%)	80	(0.5%)	270	(1.6%)
Ages 45 – 64	730	(12.8%)	290	(5.1%)	1,020	(17.9%)
Ages 65+	380	(18.4%)	150	(7.3%)	530	(25.7%)

\* This category includes Non-Hispanic adults identifying themselves as a race other than African American, Asian American, American Indian, White or identifying themselves as having more than one race.

Total percent may not equal the sum of diagnosed percent and undiagnosed percent, due to rounding.

**Table 7: Estimated Prevalence of Diabetes in Wisconsin White\* Adults by Age Group.**

Source: *The 2005 Burden of Diabetes in Wisconsin*

Age category	Estimated Number Diagnosed [%]		Estimated Number Undiagnosed [%]		Estimated Total Number [%]	
Ages 18 – 44	27,230	(1.5%)	10,890	(0.6%)	38,120	(2.1%)
Ages 45 – 64	85,780	(7.3%)	34,310	(2.9%)	120,090	(10.2%)
Ages 65+	88,460	(13.1%)	35,380	(5.2%)	123,840	(18.3%)

\* Non-Hispanic

Total percent may not equal the sum of diagnosed percent and undiagnosed percent, due to rounding.

# Estimated Diabetes Prevalence in Adults by Race/Ethnicity

Table 8 provides estimated age-adjusted adult prevalence rates per 100,000 population for the six racial/ethnic groups, as well as for all races/ethnicities combined. Rates are age-adjusted (using the direct method) to the 2000 United States standard population. Age-adjustment allows us to remove differences in the age distribution among groups, so that we are able to look at differences in rates between groups, while controlling for differences in the age variations of their populations.

**Table 8: Estimated Prevalence of Diabetes, Age-adjusted Rate per 100,000 Population,\* Wisconsin Adults (18 years and above) by Race/Ethnicity.** *Source: The 2005 Burden of Diabetes in Wisconsin*

Race/Ethnicity	Estimated Diagnosed Rate	Estimated Undiagnosed Rate	Estimated Total Rate
African American*	8,825	3,523	12,348
American Indian*	32,657	13,063	45,721
Asian American*	5,832	2,339	8,171
Hispanic/Latino	8,748	3,509	12,257
Other/Multi Race*	7,479	2,978	10,457
White*	5,156	2,062	7,218
All Races/Ethnicities	5,576	2,230	7,806

\* Rates are age-adjusted (direct method) to the 2000 United States standard population.

\* Non-Hispanic

**Figure 4: Estimated Total (Diagnosed and Undiagnosed) Percent of Adults in Wisconsin with Diabetes by Age Group and Race/Ethnicity.** *Source: The 2005 Burden of Diabetes in Wisconsin*

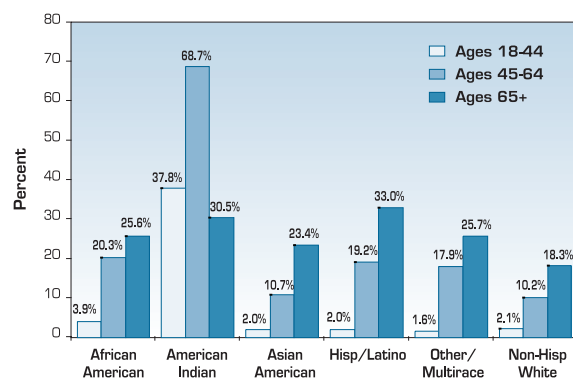
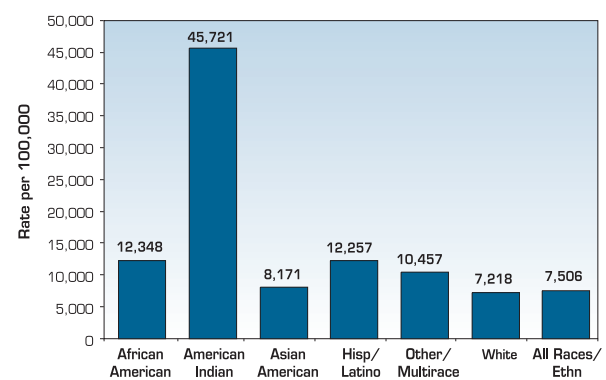


Figure 4 compares Wisconsin diabetes prevalence rates by age group for different racial and ethnic groups.

Figure 5 presents estimated age-adjusted diabetes prevalence for adults, per 100,000 population by race/ethnicity. The age-adjusted prevalence rate for American

**Figure 5: Estimated Age-adjusted Diabetes Prevalence Rate per 100,000 Population, Adults (18 years and above) by Race/Ethnicity.** *Source: The 2005 Burden of Diabetes in Wisconsin*



Indians is highest at 45,721 per 100,000 population. The age-adjusted prevalence rate for African Americans and Hispanics/Latinos is similar, at 12,348 per 100,000 population and 12,257 per 100,000 population, respectively. The lowest age-adjusted prevalence rate of all races/ethnicities is for Non-Hispanic whites at 7,218 per 100,000 population.

# Estimated Diabetes Prevalence in Children and Adolescents

Information on the prevalence of diabetes in children and adolescents is limited. The Centers for Disease Control and Prevention (CDC) estimates that approximately 210,000 people in the United States under the age of 20 have diabetes, representing approximately 0.26% of all people in this age group. In children and adolescents, the prevalence of Type 1 diabetes is much more common than Type 2 diabetes. Approximately one in every 400 to 500 children and adolescents has Type 1 diabetes.<sup>5</sup>

Type 2 diabetes is much less common in children and adolescents (this is the exact opposite in adults), but clinic-based reports and regional studies indicate that Type 2 diabetes is increasingly being seen in children and adolescents who are overweight, at risk of overweight, or physically inactive. Type 2 diabetes is also more frequently seen in children and adolescents who have a family history of Type 2 diabetes or are a member of a certain racial/ethnic group (African American, Hispanic/Latino, and American Indian descent).<sup>5,9</sup>

The Wisconsin Family Health Survey is a state-wide random-digit-dial telephone survey of households in Wisconsin. Information is included on all household members, including children.<sup>10</sup> Results from the Family Health Survey provide us with the best prevalence estimate for diabetes in Wisconsin children and adolescents. For the purpose of this report, children and adolescents are defined as 17 years and younger.

**Table 9: Estimated Prevalence of Children and Adolescents with Diabetes in Wisconsin, All Races and Ethnicities.** *Source: Wisconsin Family Health Survey, 2000-2003*

Age Category	2003 Population	Estimated Number Diagnosed (%)	
Ages 0 – 9	696,568	1,000	(0.1%)
Ages 10 – 17	643,127	3,000	(0.5%)
All ages children	1,339,695	4,000	(0.3%)

Table 9 reveals that approximately 4,000 children and adolescents aged 0-17 years in Wisconsin have been diagnosed with diabetes.<sup>11</sup> There is currently no national estimate by which to determine an estimated number of undiagnosed children and adolescents with diabetes.



# Estimated Pre-diabetes Prevalence in Adults (Ages 40-74 Years)

Pre-diabetes is defined as having blood sugar levels that are higher than normal, but not yet high enough to be diagnosed with diabetes. Before a person develops Type 2 diabetes, he/she almost always has pre-diabetes.<sup>12</sup> Recent research has shown that long-term complications can develop during pre-diabetes, including heart disease<sup>12</sup> and diabetic retinopathy.<sup>13</sup>

Information from the Centers for Disease Control and Prevention 2003 National Diabetes Fact Sheet stated 40.1% of adults aged 40-74 years have pre-diabetes.<sup>7</sup> These findings are from the 1988-1994 National Health and Nutrition Examination Survey. An estimate of the number of people with pre-diabetes in Wisconsin in the 40-74 year age group was determined, based on the population estimate for this age group. Approximately 835,800 Wisconsinites in the 40-74 year age group are estimated to have pre-diabetes (Table 10). It should be noted that the relative estimated percentage (40.1%) may be different for certain racial and ethnic groups.

**Table 10: Estimated Number of Wisconsin Adults Age 40-74 Years with Pre-diabetes by Race/Ethnicity**

	2002 WI Population Estimate [40-74 years]	Estimated Number with Pre-diabetes [40-74 years]
White*	1,914,610	767,760
African American*	84,070	33,710
American Indian/Alaska Native*	13,490	5,410
Asian*	22,340	8,960
Other/Multi*	9,270	3,720
Hispanic/Latino	40,540	16,250
Total	2,084,320	835,810

\* Non-Hispanic

In 2001, the Diabetes Prevention Program (DPP) released study results that demonstrate that lifestyle changes can prevent or delay the onset of Type 2 diabetes among high-risk adults. Persons with pre-diabetes are considered high-risk individuals. Incorporation of lifestyle interventions, such as diet and moderate-intensity physical activity (e.g., walking 150 minutes weekly) reduced the development of diabetes by 58% over three years.<sup>7</sup> Based on the estimated number of Wisconsinites aged 40-74 with pre-diabetes, the incorporation of lifestyle interventions could prevent or delay the development of diabetes for approximately 484,770 people in Wisconsin.

# Economic Costs of Diabetes

Besides serious health-related complications, diabetes is also economically costly in Wisconsin. The American Diabetes Association published an article in the March 2003 edition of *Diabetes Care*, entitled “Economic Costs of Diabetes in the U.S. in 2002.” Per capita figures in this report were obtained from this article and extrapolated to the estimated population with diabetes in Wisconsin to determine the estimated costs of diabetes in Wisconsin.

The article found that the per capita cost of medical expenditures for a person with diabetes was \$13,243. Furthermore, the article found that 69.77% of the total costs of diabetes were direct medical expenditures, while the remaining 30.23% were indirect costs due to lost productivity. This led to the per capita estimate of \$5,738 for indirect costs due to lost productivity.<sup>4</sup>

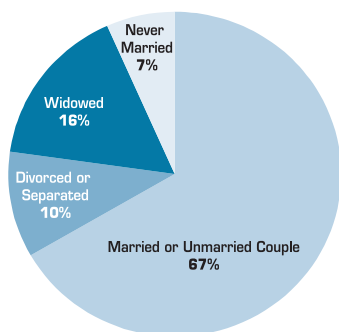
The direct (medical care) and indirect (lost productivity) costs of diabetes in Wisconsin total an estimated \$4.52 billion. Approximately \$3.12 billion are direct medical expenditures for adults, \$1.35 billion are from indirect costs for adults, and an estimated \$53 million are direct medical expenditures for children and adolescents. For this analysis, an estimate of indirect costs for children and adolescents is not included, as they are generally not members of the workforce. Note that this estimate only includes persons diagnosed with diabetes. Persons with diabetes that is undiagnosed arguably don’t incur the same costs as those diagnosed with diabetes; however, the figure of \$4.52 billion is an underestimate, as it considers none of the direct or indirect costs for persons with pre-diabetes or undiagnosed diabetes.<sup>4</sup>

# Sociodemographics

The next six sections include information obtained from the Wisconsin Behavioral Risk Factor Survey (BRFS). As explained earlier, the BRFS is a random-digit-dial telephone survey administered to Wisconsin household members 18 years and older to assess the prevalence of risk behaviors and health practices that affect health status.<sup>6</sup>

The BRFS includes a question on the core survey that determines whether or not a person has diabetes: “Have you ever been told by a doctor that you have diabetes?” Performing cross-tabulations of data on diabetes status with other conditions/risk factors of interest provides specific information on adults in Wisconsin with diabetes, compared to adults without diabetes. Wisconsin 1995-2003 BRFS data sets were used in compiling the data for the following six sections.<sup>14</sup>

**Figure 6: Marital Status of Wisconsin Adults with Diabetes.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*

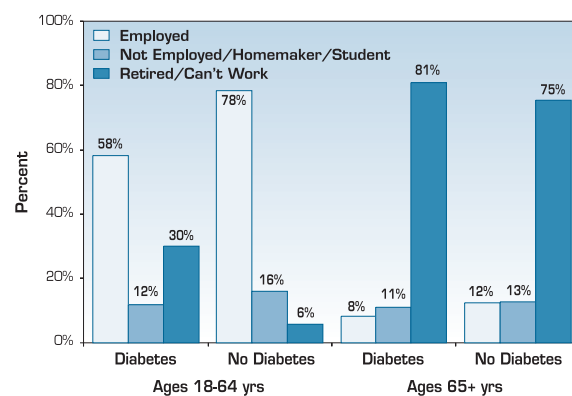


The majority (67%) of adults with diabetes are married or a member of an unmarried couple (Figure 6). Sixteen percent of adults with diabetes are widowed, 10% are divorced or separated, and 7% have never married. These percentages are similar to those for adults without diabetes, with the exception of the widowed and never married categories. For adults without diabetes, 6% are widowed and 19% have never married (data not shown).<sup>14</sup> The differences are most likely due to the fact that the prevalence of diabetes is higher in older age groups.

Figure 7 shows the employment status of adults with diabetes compared to adults without diabetes. For this analysis, two separate age groups were examined (18-64 years and 65+ years), to address the employment status differences in these two age groups. In the 18-64 year age group, 58% of adults with diabetes are employed, compared to 78% of adults without diabetes. In the same age group, a similar percent of adults with diabetes (12%) and adults without diabetes (16%) are not employed, a homemaker, or a student. In the 18-64 year age group, 30% of adults with diabetes are retired or cannot work, compared to only 6% of adults without diabetes.<sup>14</sup>

In the 65+ age group, percents are relatively similar for adults with and without diabetes. Eight percent of adults with diabetes are employed, compared to 12% of adults without diabetes. Eleven percent of adults with diabetes and 13% of adults without diabetes are not employed, a homemaker, or a student. Finally, 81% of adults with diabetes are retired or cannot work, compared to 75% of adults without diabetes.<sup>14</sup>

**Figure 7: Employment Status of Wisconsin Adults by Diabetes Status.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



*continued*

# Sociodemographics

Differences in income are also present in adults with and without diabetes. Figure 8 illustrates that people with diabetes have lower annual household incomes with just 22% earning greater than \$50,000 annually compared to 37% of those without diabetes.<sup>14</sup> The direction of causality for this is unclear.

**Figure 8: Annual Household Income of Wisconsin Adults by Diabetes Status.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*

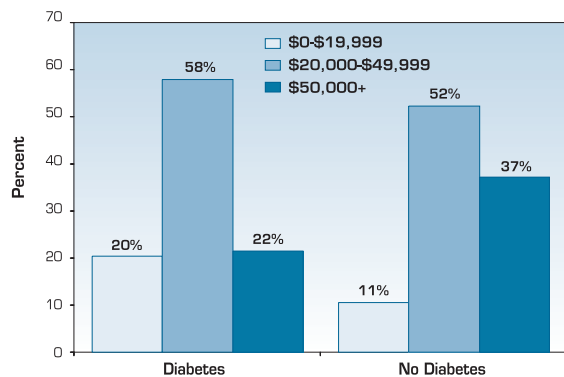
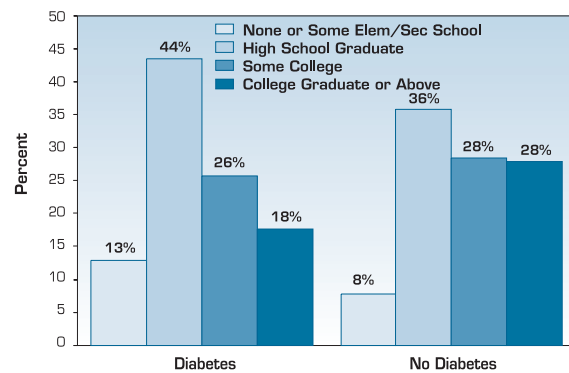


Figure 9 illustrates that the education level of adults with diabetes differs from those without diabetes. There is a greater percentage of adults with diabetes that have less than a high school education (13%), compared to people without diabetes (8%). The largest category of adults with diabetes has a high school education (44%). Twenty-eight percent of adults without diabetes have a college degree or above, compared to 18% with diabetes.<sup>14</sup>

**Figure 9: Education Level of Wisconsin Adults by Diabetes Status.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



# Risk Factors

Several risk factors are associated with an increased risk of developing Type 2 diabetes. Some of these include: overweight or obesity, physical inactivity, and several cardiovascular risk factors, such as high blood pressure and high cholesterol.

There is evidence that low physical fitness is a risk factor for many chronic conditions, including diabetes. However, given the lack of easily applied measurement tools for fitness level, physical inactivity and overweight and obesity are used as common risk factors.

In Wisconsin and nationally, there is concern about the increasing prevalence of overweight and obesity in the past decade. An overweight or obese person can be at risk of multiple chronic conditions and premature death. Some of the conditions include: cardiovascular disease, diabetes, breathing problems (sleep apnea and asthma), arthritis, complications of pregnancy, fertility issues, gall bladder disease, incontinence, depression, and some cancers.<sup>15</sup>

Body mass index (BMI) is currently used as the gold standard for determining if a person is overweight or obese. BMI is a number that shows body weight adjusted for height. Body mass index can be calculated using pounds and inches with the following equation:<sup>16</sup>

$$\text{BMI} = \left( \frac{\text{Weight in pounds}}{(\text{Height in inches}) \times (\text{Height in inches})} \right) \times 703$$

Table 11 illustrates that for adults 20 years and older, BMI falls into one of four categories: underweight, normal weight, overweight, or obese.<sup>16</sup> Examples are provided in the box in the second column.

**Table 11: Body Mass Index (BMI) and Accompanying Weight Status Categories**

BMI (in kg/m <sup>2</sup> )	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal Weight
25.0 – 29.9	Overweight
30.0 and Above	Obese

## Examples

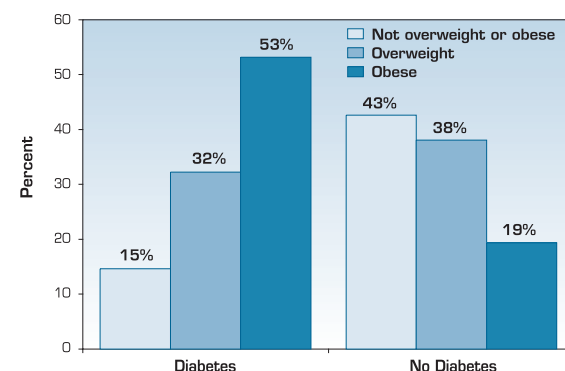
A person who is 5 feet, 0 inches would have a BMI of 25.0 kg/m<sup>2</sup> at 128 pounds, and a BMI of 30.0 kg/m<sup>2</sup> at 154 pounds.

A person who is 5 feet, 6 inches would have a BMI of 25.0 kg/m<sup>2</sup> at 155 pounds, and a BMI of 30.0 kg/m<sup>2</sup> at 186 pounds.

A person who is 6 feet, 0 inches would have a BMI of 25.0 kg/m<sup>2</sup> at 184 pounds, and a BMI of 30.0 kg/m<sup>2</sup> at 221 pounds.

The differences in percentages of adults with diabetes who are overweight or obese are drastically different than percentages for adults without diabetes (Figure 10). Only 15% of adults in Wisconsin with diabetes are not overweight or obese, compared to 43% of adults without diabetes. There are slightly more adults without diabetes that are in the overweight category (38%), compared to those with diabetes (32%). However, the majority of people with diabetes are obese (53%), in contrast to those without diabetes (19%). Therefore, 57% of adults without diabetes are overweight or obese, compared with 85% of people with diabetes.<sup>14</sup>

**Figure 10: Weight Status (Not Overweight or Obese, Overweight, Obese) in Wisconsin Adults by Diabetes Status.** Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003



Not overweight or obese: Body Mass Index < 25.0 kg/m<sup>2</sup>  
 Overweight: Body Mass Index 25.0 kg/m<sup>2</sup> – 29.9 kg/m<sup>2</sup>  
 Obese: Body Mass Index ≥ 30.0 kg/m<sup>2</sup>

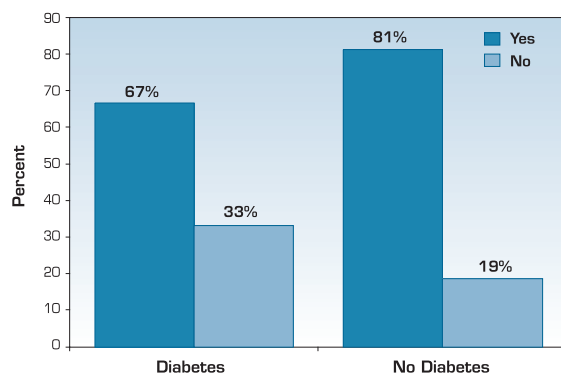
Note that adults who are underweight are not separated out from those with a normal weight, as the percentage that are underweight is very small.

# Risk Factors

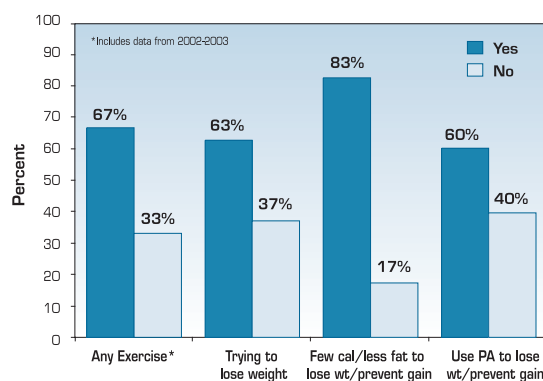
Figure 11 illustrates that 67% of adults with diabetes report some type of physical activity in the past month, compared to 81% for adults without diabetes.<sup>14</sup>

Sixty-three percent of adults with diabetes are trying to lose weight (Figure 12). Figure 12 also provides information on the techniques that adults with diabetes are using to try to lose weight. The main way (83%) that adults with diabetes are trying to lose weight (or keep from gaining) is to reduce their calories and/or fat intake.<sup>14</sup>

**Figure 11: Physical Activity Status in Wisconsin Adults by Diabetes Status.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



**Figure 12: Physical Activity and Weight Loss Information in Wisconsin Adults with Diabetes.** *Source: Wisconsin Behavioral Risk Factor Survey, 2003*

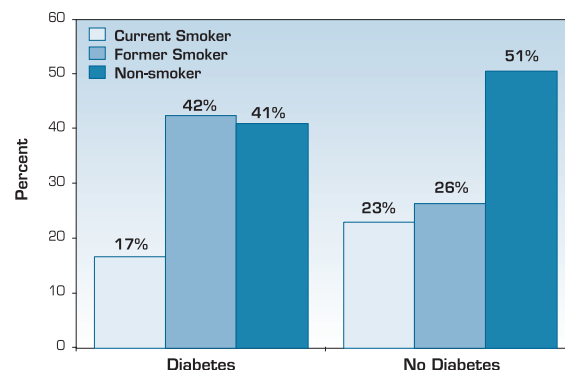


Survey data is collected from people when asked the following questions. Respondents could either answer yes or no.

- Any Exercise: During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?
- Trying to lose weight: Are you now trying to lose weight?
- Few cal/less fat to lose/prevent gain: Are you eating either fewer calories or less fat to lose weight or keep from gaining weight?
- Use PA to lose/prevent gain: Are you using physical activity or exercise to lose weight or keep from gaining weight?

Figure 13 illustrates smoking status for adults with diabetes, compared to those without diabetes. Adults with diabetes are less often current smokers (17%) than adults without diabetes (23%).<sup>14</sup> Because diabetes and smoking each by themselves lead to an increased risk of cardiovascular disease, the person with diabetes who smokes compounds his or her risk of cardiovascular disease. For the purposes of this report, current smoker is defined as an adult who has smoked at least 100 cigarettes in his/her lifetime and smokes cigarettes every day or some days. A former smoker is an adult who has smoked at least 100 cigarettes in his/her lifetime and does not currently smoke cigarettes. A non-smoker is an adult who has not smoked at least 100 cigarettes in his/her lifetime and does not currently smoke.

**Figure 13: Smoking Status (Current Smoker, Former Smoker, Non-smoker) in Wisconsin Adults by Diabetes Status.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



# Risk Factors

Table 12 provides information on the percent of adults with diabetes who responded regarding selected cardiovascular-related conditions. Ninety-seven percent of adults with diabetes have responded that they have ever had their cholesterol checked. Of those adults, 58% percent had been told that their cholesterol was high. Sixty-six percent of adults with diabetes responded that they had ever been told that their blood pressure was high, and of those, 87% are taking medication for their high blood pressure.<sup>14</sup>

**Table 12: Percent of Wisconsin Adults with Diabetes who Responded to Selected Cardiovascular-related Conditions.** *Source: Wisconsin Behavioral Risk Factor Survey, 2003*

	Yes	No
Ever had cholesterol checked <sup>a</sup>	97%	3%
Ever been told cholesterol high <sup>b</sup>	58%	42%
Ever told blood pressure high <sup>c</sup>	66%	34%
Taking medication for high blood pressure <sup>d</sup>	87%	13%

<sup>a</sup> Question asked: "Blood cholesterol is a fatty substance found in the blood. Have you ever had your blood cholesterol checked?"

<sup>b</sup> Question asked: "Have you ever been told by a doctor, nurse, or other health care professional that your blood cholesterol is high?" (This question was asked only of those who answered "yes" to the above question.)

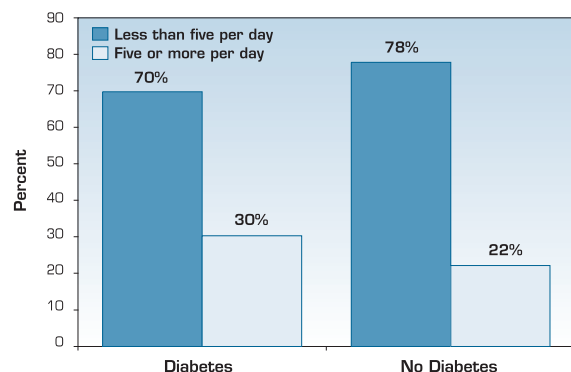
<sup>c</sup> Question asked: "Have you ever been told by a doctor, nurse, or other health care professional that you have high blood pressure?"

<sup>d</sup> Question asked: "Are you currently taking medicine for your high blood pressure?" (This question was asked only of those who answered "yes" to the above question.)

In general, the majority of Wisconsin adults do not eat the recommended five fruits and vegetables a day. However, Figure 14 illustrates that adults with diabetes report meeting the recommendations slightly more often relative to adults without diabetes. Thirty percent of adults with diabetes eat the recommended five fruits and vegetables a day, compared to 22% of adults without diabetes.<sup>14</sup>

**Figure 14: Fruit and Vegetable Consumption Status in Wisconsin Adults by Diabetes Status.**

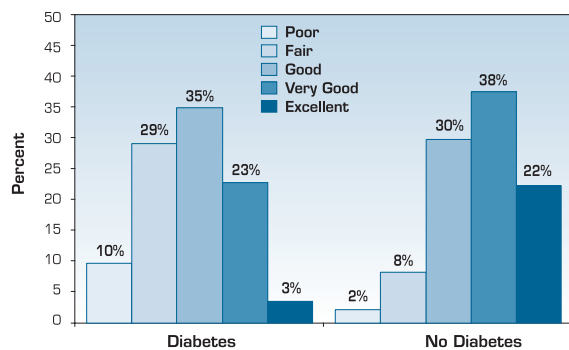
*Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



## Self-reported General Health

Adults with diabetes report their health status as less positive than adults without diabetes (Figure 15). Adults with diabetes rate their health as poor five times as often (10%) as do adults without diabetes (2%). Twenty-nine percent of adults with diabetes rate their health as fair, compared to only 8% of adults without diabetes. Only three percent of adults with diabetes report their health status as excellent, compared to 22% of adults without diabetes.<sup>14</sup>

**Figure 15: Self-reported General Health Status (Excellent, Very Good, Good, Fair, or Poor) in Wisconsin Adults by Diabetes Status.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*

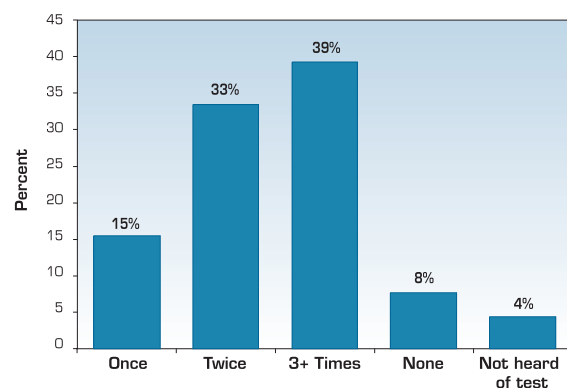


## Current Status of Diabetes Care

Wisconsin has been including questions on the Behavioral Risk Factor Survey (BRFS) diabetes module since 1995. The diabetes module poses a set of diabetes-specific questions to anyone who has answered “Yes” to the question “Have you ever been told by a doctor that you have diabetes?” The diabetes module includes questions on typical lab tests and exams that a person with diabetes should receive.

An A1C (also referred to as hemoglobin A1C or glycosylated hemoglobin) test is a measure of a person’s blood sugar control over the past 60 to 90 days. The American Diabetes Association recommends testing the A1C a minimum of two times a year, depending on the clinical situation, type of treatment, and judgment of the clinician.<sup>3</sup> Eighty-seven percent of adults with diabetes in Wisconsin have had an A1C test at least once in the past year, and 72% of adults with diabetes have had two or more A1C tests within the past year. Eight percent of adults had not had an A1C test within the past year, and 4% of adults had not heard of the test (Figure 16).<sup>14</sup>

**Figure 16: Self-reported Frequency of A1C Test in Past Year for Wisconsin Adults with Diabetes.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



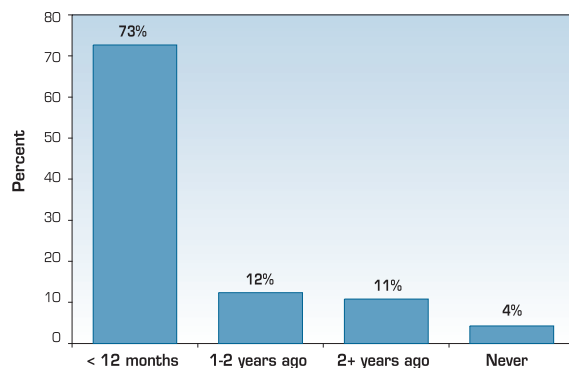


# Current Status of Diabetes Care

Diabetic retinopathy is a complication of diabetes that causes blindness. Early detection and treatment of diabetic retinopathy can prevent or delay blindness. A dilated retinal eye exam by an experienced optometrist or ophthalmologist is the most reliable test to assess for diabetic retinopathy. It is recommended that a person with diabetes have a dilated eye exam each year. There are two exceptions, which are explained in detail in the Wisconsin Essential Diabetes Mellitus Care Guidelines.<sup>3</sup>

One of the BRFS diabetes module questions queries respondents about whether they have had a dilated retinal eye exam in the past year. Figure 17 illustrates that 73% of adults in Wisconsin with diabetes have had a dilated eye exam in the past year, with 23% having had an exam more than a year ago. Four percent of adults with diabetes report never having had a dilated eye exam.<sup>14</sup>

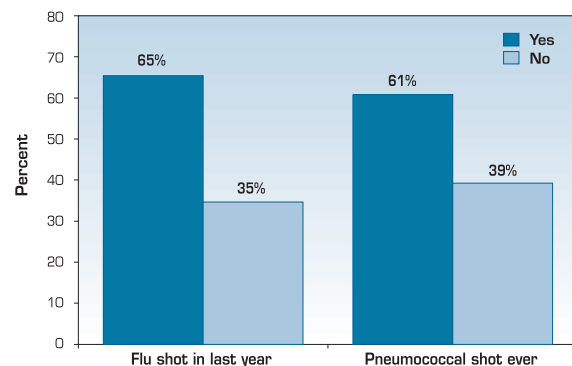
Figure 17: Self-reported Time Respondent had Last Dilated Eye Exam for Wisconsin Adults with Diabetes. *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



Adults with diabetes are more susceptible to infections, including influenza and pneumonia. The Wisconsin Essential Diabetes Mellitus Care Guidelines recommend that persons with diabetes have an annual influenza vaccination, as well as a pneumococcal vaccination.<sup>3</sup>

Figure 18 illustrates that 65% of adults with diabetes reported having had the influenza vaccination within the past year and 61% of adults with diabetes report having ever had a pneumococcal vaccination.<sup>14</sup>

Figure 18: Self-reported Responses for Wisconsin Adults with Diabetes Regarding Receiving Flu Shot in Past Year and Pneumococcal Shot Ever. *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*



continued

# Current Status of Diabetes Care

Healthy People 2010 is a set of health objectives for the Nation to achieve in the first decade of the new century. Healthy People 2010 has two overarching goals: 1) to increase the quality and years of healthy life and 2) to eliminate health disparities. Diabetes is one of the 28 focus areas in Healthy People 2010.<sup>17</sup>

Figure 19 shows five diabetes-related measures, along with the Healthy People 2010 target for each measure, where applicable. Wisconsin has already reached and surpassed the Healthy People 2010 target for A1C testing, with 88% of adults with diabetes reporting having received an A1C test one or more times in the past year. Eighty-nine percent of adults with diabetes report having had one or more doctor's visits in the past year; there is no Healthy People 2010 target for this measure.<sup>17</sup>

Wisconsin is close to reaching the Healthy People 2010 targets for the other three diabetes-related measures. Seventy-three percent of adults with diabetes report having had a dilated eye exam in the past year, with a Healthy People 2010 target of 75%. Sixty-nine percent of adults with diabetes report having had a foot exam in the past year, with a Healthy People 2010 target of 75%. Finally, 71% of adults with diabetes report having had a dental exam in the past year, with a Healthy People 2010 target of 75%.<sup>14</sup>

**Figure 19: Self-reported Selected Diabetes Care Measures for Wisconsin Adults with Diabetes and Associated Healthy People 2010 Targets.**  
*Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*

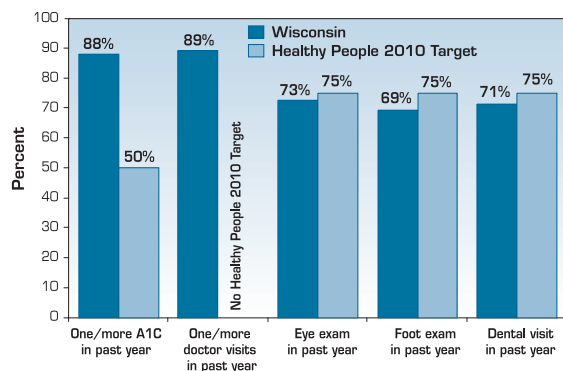
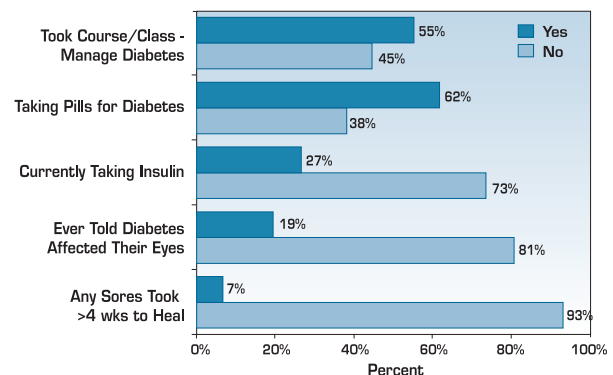


Figure 20 illustrates self-reported responses from adults with diabetes regarding selected aspects of diabetes care. Fifty-five percent of adults with diabetes report having ever taken a course or a class in how to manage their diabetes themselves. Sixty-two percent of adults with diabetes report taking pills for their diabetes, while 27% report currently taking insulin. Nineteen percent of adults with diabetes report that they have ever been told by a doctor that diabetes has affected their eyes or that they had retinopathy, and 7% of adults with diabetes report that they have ever had any sores or irritations on their feet that took more than four weeks to heal.<sup>14</sup>

**Figure 20: Self-reported Responses for Wisconsin Adults with Diabetes Regarding Selected Aspects of Diabetes Care.** *Source: Wisconsin Behavioral Risk Factor Survey, 2002-2003*

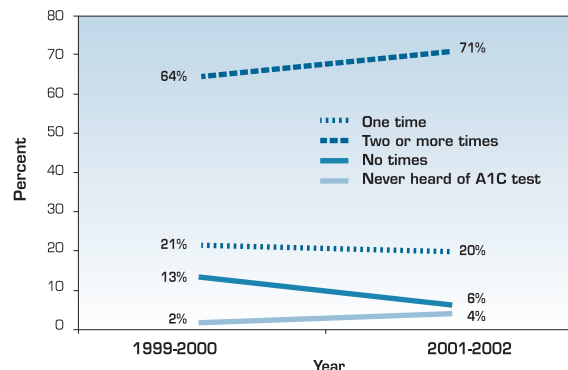


# Trends in Diabetes Care

It is important to examine how diabetes care has changed over time. Because the diabetes module questions have been asked since 1995, changes in diabetes care over time can be reviewed. In many of the following graphs, two years have been combined for one data point, as this provides a more accurate and stable estimate over time.

Figure 21 illustrates the percent of adults with diabetes who reported the number of times they had an A1C test in the past year. Data are only available from 1999-2002, as the survey question changed in 1999, and data prior to 1999 are not comparable to current data. The percent of adults with diabetes who report having one A1C test in the past year has remained fairly constant from the 1999-2000 to the 2001-2002 time period. However, the percent of adults with diabetes reporting two or more A1C tests in the past year has increased from 64% to 71% during the same time period. The percent of adults who report that they have never had an A1C test has decreased from 13% to 6% over the same time period.<sup>14</sup>

**Figure 21: Percent of Wisconsin Adults with Diabetes Who Have Self-reported Having Their Hemoglobin A1C Tested in the Past Year (One Time, Two or More Times, No Times), and the Percent of Wisconsin Adults with Diabetes Who Have Never Heard of the Term A1C, 1999-2002.** *Source: Wisconsin Behavioral Risk Factor Survey, 1999-2002. Data not available for 1995-1998 because survey question changed in 1999.*



The percent of adults who report having seen a health professional for their diabetes has changed slightly, especially since 1999-2000. It appears fewer people report not seeing a health professional than in the past, and fewer people are seeing a health professional more than five times in the past

year. Furthermore, since 1997-1998, fewer people are seeing a health professional one to two times in the past year. It appears that the percentage of adults with diabetes who see a health professional three to four times in the past year has been steadily increasing since 1995-1996, as shown in Figure 22.<sup>14</sup>

**Figure 22: Percent of Wisconsin Adults with Diabetes Who Self-reported Having Seen a Doctor, Nurse, or Other Health Professional in the Past Year for their Diabetes, 1995-2002.** *Source: Wisconsin Behavioral Risk Factor Survey, 1995-2002*

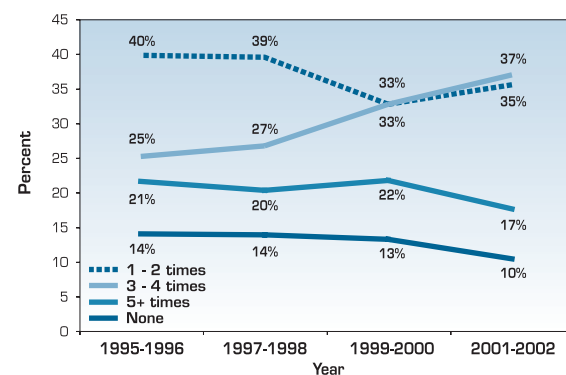
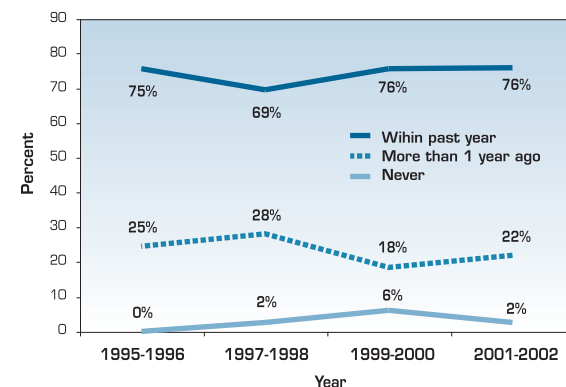


Figure 23 illustrates trends in the percent of adults who received a dilated eye exam in the past year. The percent of adults receiving a dilated retinal eye exam in the past year has remained fairly constant since 1995-1996, as has the percent of adults reporting never having had an eye exam, and those reporting that they have had an eye exam more than a year ago.<sup>14</sup>

**Figure 23: Percent of Wisconsin Adults with Diabetes Who Have Received a Dilated Eye Exam Within the Past Year, More than One Year Ago, and Never, 1995-2002.** *Source: Wisconsin Behavioral Risk Factor Survey, 1995-2002*



# Trends in Diabetes Care

Since 1995-1996, the percentage of adults who report having had their feet checked by a health professional in the past year has increased. In 2001-2002, 77% of adults with diabetes reported having received a foot exam in the past year from a health professional, up from 69% in 1995-1996, as seen in Figure 24.<sup>14</sup>

Figure 24: Percent of Wisconsin Adults with Diabetes Reporting the Number of Times a Health Professional Has Checked Their Feet in the Past Year, 1995-2002. Source: Wisconsin Behavioral Risk Factor Survey, 1995-2002

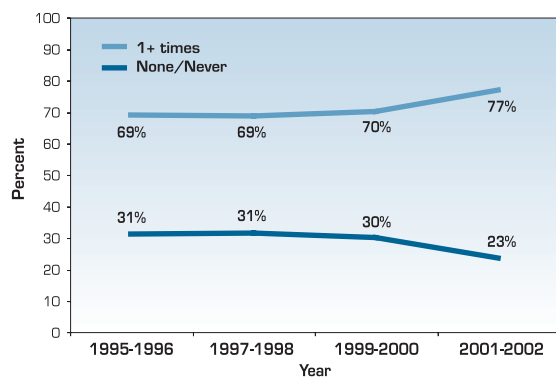
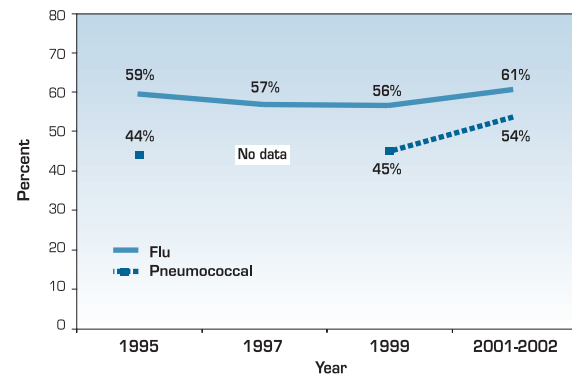


Figure 25 illustrates trends in influenza and pneumococcal vaccinations from 1995 to 2001-2002. For this measure, single years are used as data points in some cases, if the question was not asked in a particular year. Furthermore, for 1997, the sample size for the pneumococcal vaccination question was not large enough to report data on, so this information is not included. The percent of people with diabetes reporting that they received an influenza vaccination in the past year has remained fairly stable over time and reached 61% in 2001-2002. The percent of people with diabetes who report ever having received a pneumococcal vaccination has increased from 44% in 1995 to 54% in 2001-2002.<sup>14</sup>

Figure 25: Percent of Wisconsin Adults with Diabetes Who Report They Have Had a Flu Shot in the Past Year (1995-2002) and Percent of Adults with Diabetes Who Report They Have Ever Had a Pneumococcal Shot (1995 and 1999-2002). Source: Wisconsin Behavioral Risk Factor Survey, 1995-2002. Data not available for pneumococcal shot in 1997, because sample size too small



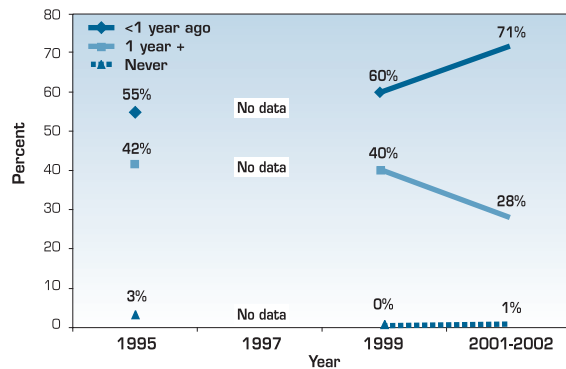
Adults with diabetes are more prone to oral infections and diseases than are people without diabetes. For this reason, the Wisconsin Essential Diabetes Mellitus Care Guidelines recommends that adults with diabetes should receive a dental exam at diagnosis and at least once every six months.<sup>3</sup> A question on the BRFS asks respondents if they have visited a dentist within the past year.

As in the influenza and pneumococcal vaccination graph, single years are used as data points in some cases, if the question was not asked in a particular year. Furthermore, the dental visit question was not asked in 1997, and therefore, there is no data for this year. In 1995, the percentage of adults with diabetes who report last seeing a dentist within the past year was 55%; by 2001-2002, this percent had increased to 71%. Simultaneously, the percent of adults with diabetes who reported a dental visit more than a year ago decreased from 42% in 1995 to 28% in 2001-2002. Figure 26 illustrates that the percent of adults with diabetes who report never having seen a dentist remained consistently low throughout the period of interest.<sup>14</sup>

## Trends in Diabetes Care

Figure 26: Percent of Wisconsin Adults with Diabetes Reporting When They Had Last Been Seen by a Dentist, 1995-2002.

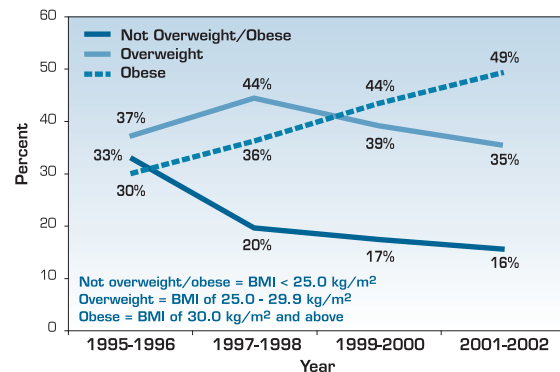
Source: Wisconsin Behavioral Risk Factor Survey, 1995-2002. Data not available in 1997, as the survey question was not asked in this year.



## Trends in Selected Characteristics of Adults with Diabetes

The percent of adults with diabetes who reported a weight that did not classify them as overweight or obese according to BMI (see discussion on page 13) has decreased from 33% in 1995-1996 to 16% in 2001-2002 (Figure 27). Concurrently, the percentage of adults with diabetes reporting overweight peaked in 1997-1998 at 44%, and then decreased to 35% in 2001-2002. The percentage of adults with diabetes reporting obesity increased from 30% to 49% during the same period of time. The percentage of adults with diabetes who are overweight or obese has drastically increased over the past eight years.<sup>14</sup>

Figure 27: Percent of Wisconsin Adults with Diabetes Self-reporting a Weight Corresponding to (1) Not Overweight or Obese, (2) Overweight, and (3) Obese, 1995-2002. Source: Wisconsin Behavioral Risk Factor Survey, 1995-2002



continued

# Trends in Selected Characteristics of Adults with Diabetes

Figure 28 illustrates that the percentage of adults without diabetes who are overweight or obese has increased over time, but to a lesser extent than the percentage of adults with diabetes who are overweight or obese. From 1995-1996 to 2001-2002, the percentage of adults without diabetes who are overweight or obese increased from 53% to 57%, a relative increase of 8%. During the same time, the percentage of adults with diabetes who are overweight or obese increased from 67% to 84%, a relative increase of 25%.<sup>14</sup>

**Figure 28: Percent of Wisconsin Adults Self-reporting a Weight Corresponding to Not Overweight/Obese OR Overweight/Obese by Diabetes Status, 1995-2002.** *Source: Wisconsin Behavioral Risk Factor Survey, 1995-2002*

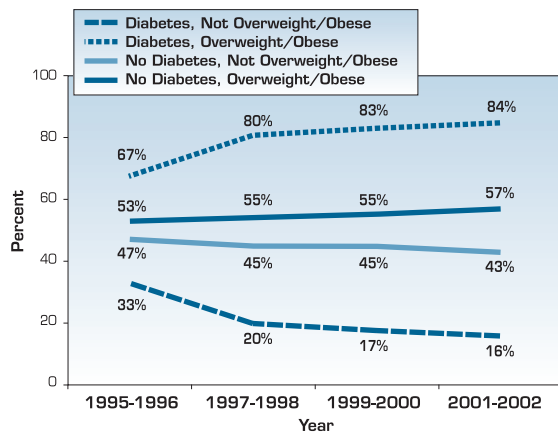
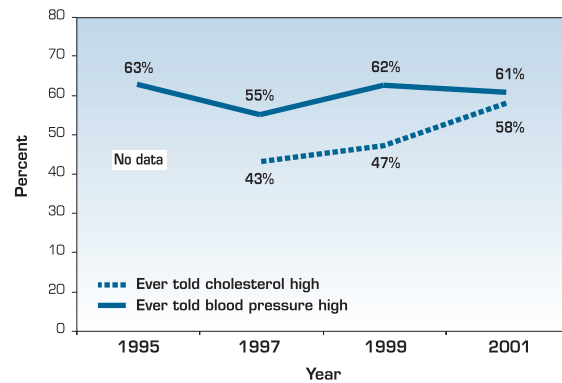


Figure 29 illustrates that the percent of adults with diabetes reporting they had been told they have high blood pressure has remained relatively stable, with a low point of 55% in 1997. However, the percent of adults reporting being told by a health professional that they have high cholesterol has increased from 43% in 1997 to 58% in 2001 (Figure 29). In Figure 29, single years are used as data points, as the questions were not asked in even-numbered years. Information on high blood cholesterol prevalence is not shown for 1995, as the sample size for this measure and year was not large enough to report that year.<sup>14</sup>

**Figure 29: Percent of Wisconsin Adults with Diabetes Who Report They Have Ever Been Told That Their Cholesterol or Blood Pressure is High, 1995-2001.** *Source: Wisconsin Behavioral Risk Factor Survey, 1995-2001. Data on cholesterol is not available for 1995 because sample size is too small.*



# Diabetes-related Inpatient Hospitalizations

Diabetes is often considered an ambulatory care condition, one in which opportune and effective primary care can possibly reduce diabetes-related hospitalizations. While some diabetes-related hospitalizations are anticipated, many of these hospitalizations can be prevented with optimal control and management of diabetes. Access to quality diabetes care, receiving the recommended tests and exams, and increasing or enhancing self-management skills (including support for behavior and lifestyle change) may help decrease the number of diabetes-related inpatient hospitalizations.

A study by the Agency for Healthcare Research and Quality reported in March 2005 that the United States could save almost \$2.5 billion annually by preventing diabetes-related hospitalizations. This study also found in 2001, 30% of people with diabetes who were hospitalized had two or more hospital stays during that year.<sup>18</sup>

When a person is admitted to a hospital, the main reason for the admission is recorded as the principal diagnosis. In many cases, one or more “Other Diagnosis” codes are listed as well. A diabetes-related condition (such as diabetic ketoacidosis) or diabetes itself may be listed in one or more of these “Other Diagnosis” codes.

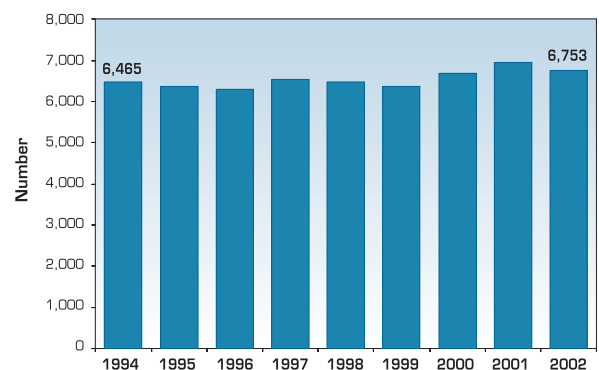
Prior to the fourth quarter of 1993, in Wisconsin, there was one “Principal Diagnosis” space and four “Other Diagnosis” spaces utilized in recording hospitalization information. Beginning with the fourth quarter of 1993, four additional “Other Diagnosis” spaces were added in the collection of hospitalization information, for a total of eight “Other Diagnosis” spaces. Data examining diabetes-related hospitalizations are only presented for years 1994 and after, to allow for comparison of consistent data during the time period.

All data provided in this section and the “Diabetes-related Lower-extremity Amputations” section are from the Wisconsin Inpatient Hospitalization Discharge Database. These data include all ages (children, as well as adults), but do not include hospitalizations at any Veteran’s Administration (VA) hospitals, which are exempt from state reporting requirements. Therefore, data on inpatient hospitalizations and amputations are likely underreported. Hospitalizations for non-Wisconsin

residents and for Wisconsin residents hospitalized outside of Wisconsin are not included.

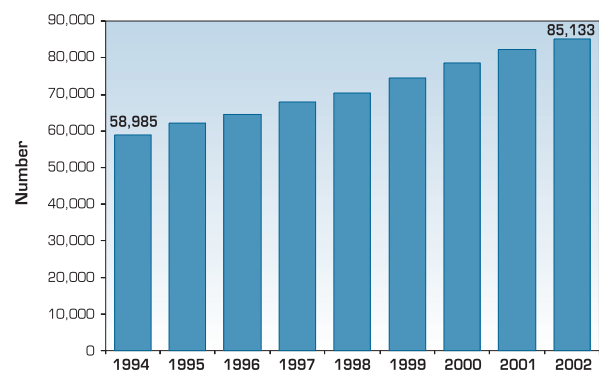
Figure 30 illustrates that the raw number of inpatient hospital discharges where diabetes was listed as the principal diagnosis has increased from just over 6,450 in 1994 to over 6,750 in 2002.<sup>19</sup>

Figure 30: Number of Hospital Discharges with Diabetes Listed as the Principal Diagnosis, Wisconsin Residents, 1994-2002. Source: Wisconsin Inpatient Hospitalization Discharge Database



Diabetes can be listed as the principal diagnosis and/or as one or more of the other diagnoses. The raw number of inpatient hospitalization discharges where diabetes was listed as any diagnosis is presented in Figure 31. Almost 59,000 inpatient hospitalizations occurred in 1994; this number increased to over 85,000 by 2002.<sup>19</sup>

Figure 31: Number of Hospital Discharges with Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002. Source: Wisconsin Inpatient Hospitalization Discharge Database





# Diabetes-related Inpatient Hospitalizations

In 2002, there were a total of 629,009 hospitalizations of Wisconsin residents in Wisconsin hospitals. Of those, 85,133 hospitalizations had diabetes listed as a principal or other diagnosis. In effect, 13.5% of all Wisconsin hospitalizations were diabetes-related, as shown in Figure 32.<sup>19</sup>

**Figure 32: Percent of All Hospitalizations that were Diabetes-related, when Diabetes is Listed as Any Diagnosis, Wisconsin Residents, 2002.**

*Source: Wisconsin Inpatient Hospitalization Discharge Database*

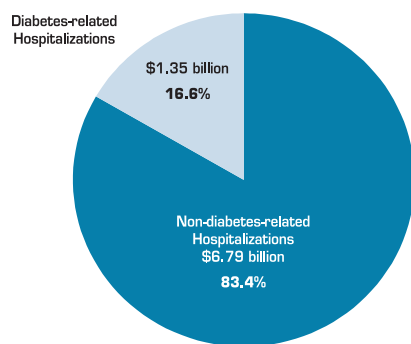


Figure 33 illustrates the percent of total hospitalization charges related to diabetes for Wisconsin residents. In 2002, there were \$8.14 billion in hospitalization charges for Wisconsin residents. Of this, 16.6%, or \$1.35 billion, was diabetes-related.<sup>19</sup>

**Figure 33: Percent of All Hospitalization Charges that were Diabetes-related, when Diabetes is Listed as Any Diagnosis, Wisconsin Residents, 2002.**

*Source: Wisconsin Inpatient Hospitalization Discharge Database*

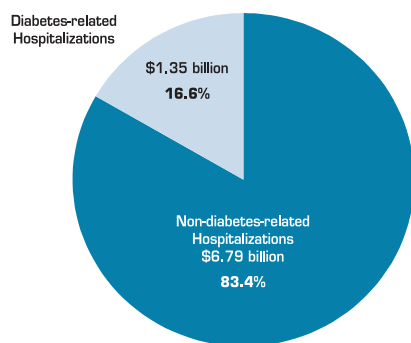


Figure 34 illustrates the age-adjusted rate for inpatient hospitalization discharges when diabetes is listed as the principal diagnosis from 1994 to 2002. Rates were age-adjusted to the 2000 United States standard population. Age-adjustment allows us to remove differences in the age distribution over time, so that we are able to look at changes in rates over time while controlling for fluctuations in the age distribution of the population. The age-adjusted rate has remained very constant over time.<sup>19</sup>

**Figure 34: Age-adjusted Rates per 10,000 Population of Hospital Discharges with Diabetes Listed as the Principal Diagnosis, Wisconsin Residents, 1994-2002.** *Source: Wisconsin Inpatient Hospitalization Discharge Database*

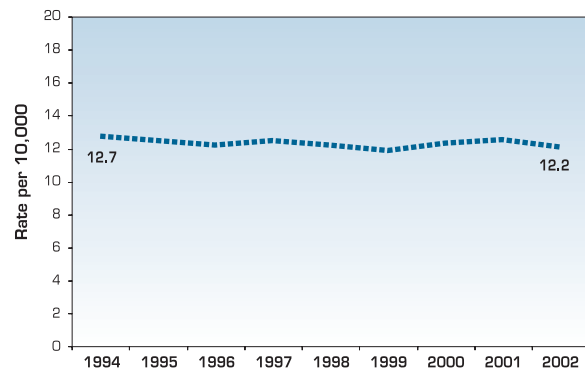
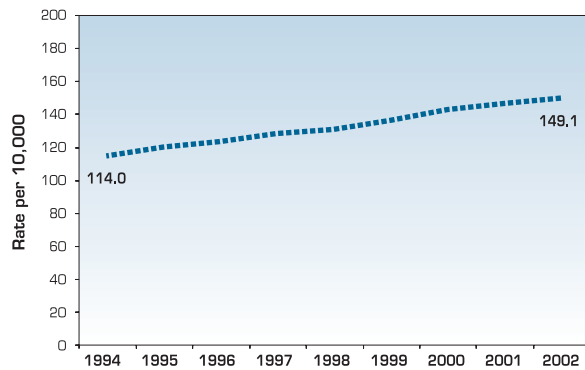


Figure 35 shows the age-adjusted rate for inpatient hospitalization discharges when diabetes is listed as any diagnosis (principal diagnosis or any of the other diagnoses) from 1994 to 2002. The age-adjusted rate increased from 114.0 diabetes-related discharges per 10,000 population in 1994 to 149.1 diabetes-related discharges per 10,000 population in 2002. The rate has increased consistently each year during this time period.<sup>19</sup>



# Diabetes-related Inpatient Hospitalizations

Figure 35: Age-adjusted Rates per 10,000 Population of Hospital Discharges with Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002. Source: Wisconsin Inpatient Hospitalization Discharge Database



Age-specific inpatient hospitalization discharge rates are presented in Figure 36. These rates correspond to discharges in which diabetes is listed as the principal diagnosis. The figure shows that, as expected, rates for hospitalizations where diabetes is the principal diagnosis are lowest for the youngest age groups. Rates have remained fairly stable over time for all age groups, with some minor variation in the 65 years and older age group.<sup>19</sup>

Figure 36: Age-specific Rates per 10,000 Population of Hospital Discharges with Diabetes Listed as the Principal Diagnosis, Wisconsin Residents, 1994-2002. Source: Wisconsin Inpatient Hospitalization Discharge Database

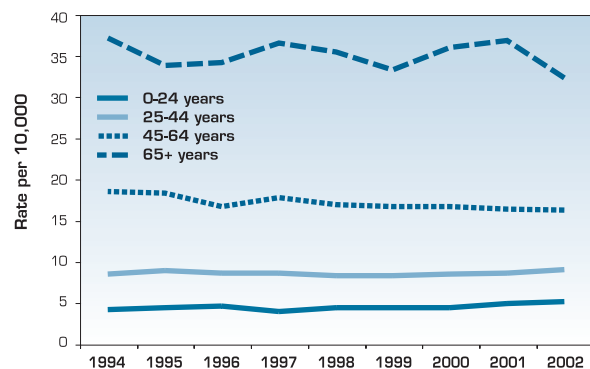
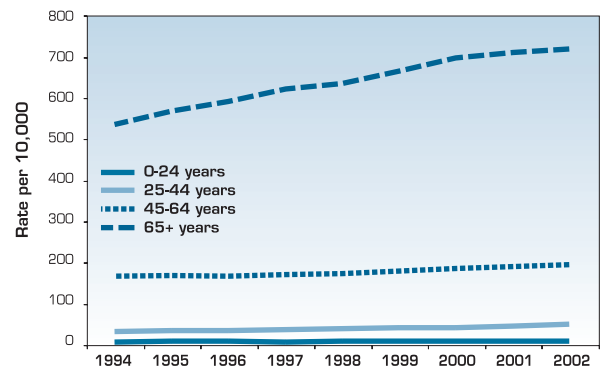


Figure 37 illustrates age-specific inpatient hospitalization discharge rates when diabetes is listed as any diagnosis (either the principal diagnosis or any of the other diagnoses). Similar to age-specific rates where diabetes was the principal diagnosis, younger age groups have lower rates. Rates for all groups, except the 65 years and older age group, have remained fairly consistent from 1994 to 2002. The rate for the 65 years and older age group has increased from 535 per 10,000 population in 1994 to 718 per 10,000 population in 2002.<sup>19</sup>

Figure 37: Age-specific Rates per 10,000 Population of Hospital Discharges with Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002. Source: Wisconsin Inpatient Hospitalization Discharge Database



continued

# Diabetes-related Inpatient Hospitalizations

Figure 38 illustrates that the average length of stay for a diabetes-related hospitalization is higher than the average length of stay for a non-diabetes-related hospitalization. For diabetes-related hospitalizations, the average length of stay has decreased from 6.5 days in 1994 to 5.1 days in 2002. The average length of stay for non-diabetes-related hospitalizations has decreased from an average of 5.2 days in 1994 to an average of 4.5 days in 2002. In general, the average length of stay for a hospitalization has decreased over the past 12 years.<sup>19</sup>

Figure 38: Mean Length of Stay (days) of Persons with Inpatient Hospital Discharges, Diabetes-related and Non-diabetes-related, Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002. Source: Wisconsin Inpatient Hospitalization Discharge Database

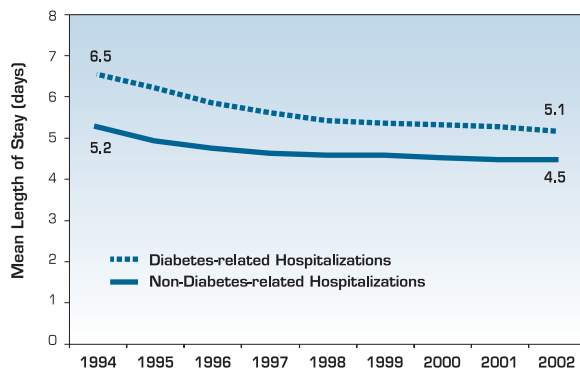
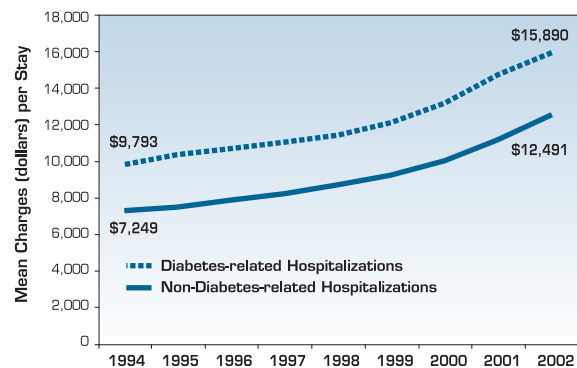


Figure 39 shows the average charges for a diabetes-related hospitalization, compared with a non-diabetes-related hospitalization from 1994 to 2002. Charges for a hospitalization, whether it be a diabetes-related or non-diabetes-related one, have nearly doubled in the past 8 years, despite the average length of stay decreasing. However, in general, a diabetes-related hospital discharge incurs more charges than does a non-diabetes-related discharge. The difference between diabetes-related hospital charges and non-diabetes-related hospital charges has remained fairly consistent over time.<sup>19</sup>

Figure 39: Mean Charges Associated with Inpatient Hospitalizations, Diabetes-related and Non-diabetes-related, Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002. Source: Wisconsin Inpatient Hospitalization Discharge Database



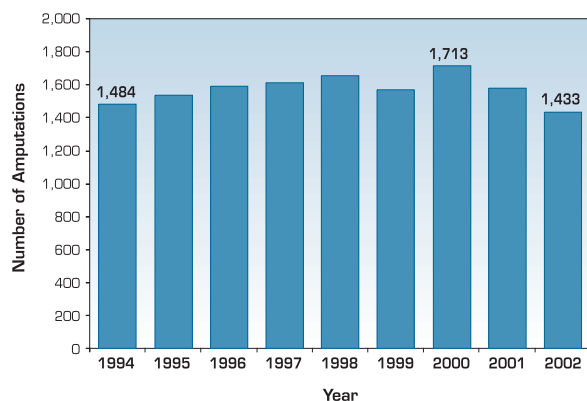
# Diabetes-related Lower-extremity Amputations

Diabetes is the leading cause of lower-extremity amputations, a serious and disabling complication.<sup>20</sup> Neuropathy and peripheral vascular disease are two common conditions seen in adults with diabetes, and may result in increased risk of amputation.

With respect to the recording of hospitalization and lower-extremity amputation information, prior to the fourth quarter of 1993, in Wisconsin, there was one “Principal Diagnosis” space, four “Other Diagnosis” spaces, one “Principal Procedure” space, and two “Other Procedure” spaces utilized in recording information. Beginning with the fourth quarter of 1993, four additional “Other Diagnosis” spaces and three additional “Other Procedure” spaces were added in the collection of hospitalization information, for a total of eight “Other Diagnosis” and five “Other Procedure” spaces. Data examining non-traumatic lower-extremity amputations when the diabetes is listed as any diagnosis are only presented for years 1994 and after, to allow for comparison of consistent data during the time period.

Figure 40 illustrates the raw number of non-traumatic lower-extremity amputations that were performed when diabetes was listed as any diagnosis. In 1994, there were 1,484 non-traumatic lower-limb amputations performed, while in 2002, there were 1,433 performed.

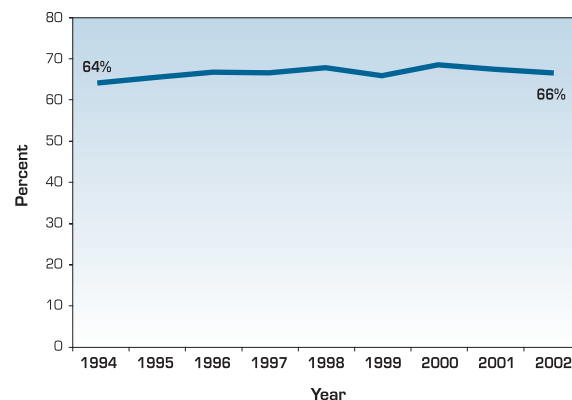
**Figure 40: Number of Non-traumatic Lower-extremity Amputations with Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002.** *Source: Wisconsin Inpatient Hospitalization Discharge Database*



In the United States, an estimated 44%-85% of lower-extremity amputations could be prevented with increased foot care programs.<sup>21</sup> In Wisconsin, this would translate to prevention of approximately 600 to 1,200 amputations every year.

Figure 41 illustrates the percentage of all lower-extremity amputations performed in Wisconsin hospitals that were diabetes-related. In this figure, diabetes-related is defined as diabetes being listed as any diagnosis. The percent has not changed a great deal from 1994 to 2002.<sup>19</sup>

**Figure 41: Percent of All Lower-extremity Amputations Performed in Wisconsin Hospitals that were Diabetes-related. Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002.** *Source: Wisconsin Inpatient Hospitalization Discharge Database*



*continued*

# Diabetes-related Lower-extremity Amputations

Figure 42 presents trends in the age-adjusted rate of non-traumatic lower-extremity amputations where diabetes is listed as any diagnosis, and a lower-extremity amputation is listed as any procedure. The age-adjusted lower-extremity amputation rate has remained fairly stable over the past 8 years, with a high of 3.1 amputations per 10,000 population in 2000. The past couple of years suggests a small downward trend, the significance of which is unknown at the time.<sup>19</sup>

**Figure 42: Age-adjusted Rates per 10,000 Population of Non-traumatic Lower-extremity Amputations with Diabetes Listed as Any Diagnosis, Wisconsin Residents, 1994-2002.**  
*Source: Wisconsin Inpatient Hospitalization Discharge Database*

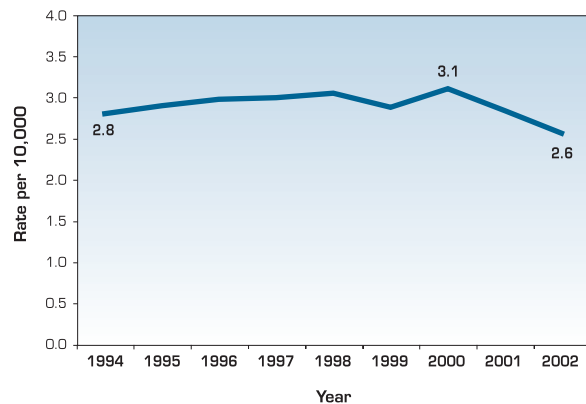
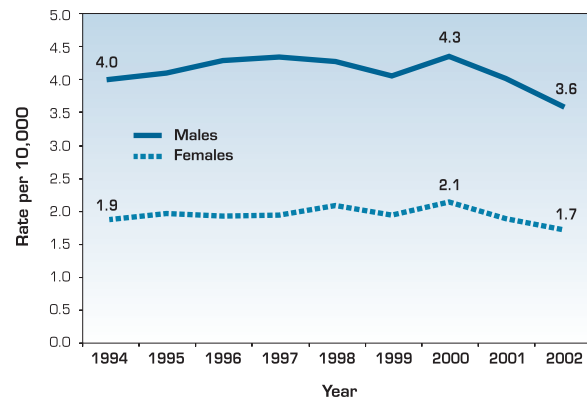


Figure 43 presents trends in the age-adjusted rate of non-traumatic lower-extremity amputations by sex, where diabetes is listed as any diagnosis, and a lower-extremity amputation is listed as any procedure. Of note, the lower-extremity amputation rate for males was double that for females during the entire span of time covered in the figure.<sup>19</sup>

**Figure 43: Age-adjusted Rates per 10,000 Population of Non-traumatic Lower-extremity Amputations with Diabetes Listed as Any Diagnosis by Sex, Wisconsin Residents, 1994-2002.**  
*Source: Wisconsin Inpatient Hospitalization Discharge Database*



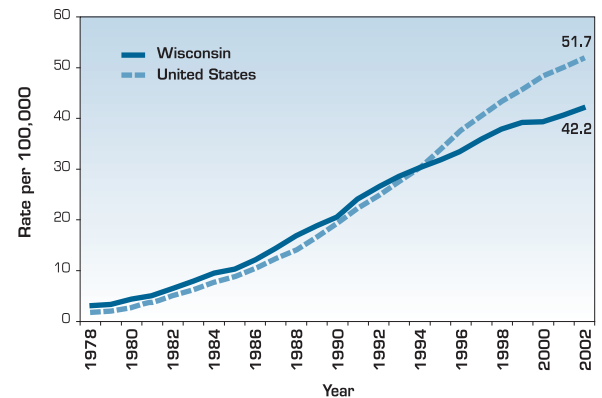
# End-stage Renal Disease

End-stage renal disease (ESRD) is a complication of diabetes where the kidneys no longer function normally. Typically, in ESRD, the kidneys function at less than 10% of their normal capacity. When ESRD occurs, either dialysis (filtering of the blood completed by a machine) or a kidney transplant is required for survival. In the United States, approximately 40% of all new cases of ESRD are from adults with diabetes. Diabetes is the leading cause of ESRD.<sup>22</sup> Kidney function can be preserved and the disease process slowed or prevented by optimal blood sugar and blood pressure control. Use of certain blood pressure medications (i.e., ace inhibitors and angiotensin receptor blockers [ARBs]) have also been shown to slow progress of disease.<sup>3</sup>

Data in this report is from the United States Renal Data System (USRDS). A web-based query program (ReNDER) was used to obtain the numbers of incident and prevalent ESRD in Wisconsin from 1978 through 2002.<sup>23</sup> All data were age-adjusted to the 2000 United States standard population. Data on prevalence and incidence of ESRD are presented below. Prevalence is the **total** number of cases of a condition in a population in a specified period of time (usually a year), while incidence is the number of **new** cases of a condition in a specified period of time (usually a year).

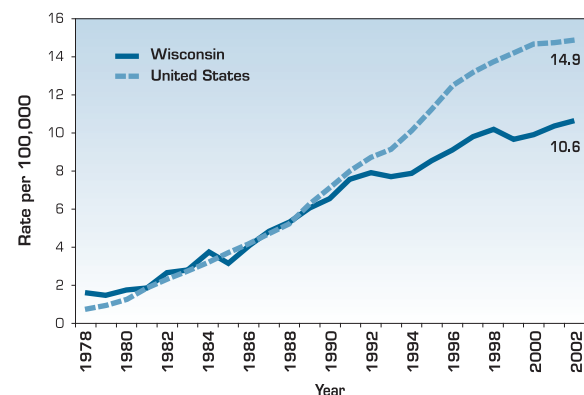
Figure 44 illustrates the age-adjusted prevalence rate of ESRD in Wisconsin and the United States from 1978 to 2002 when the primary diagnosis is diabetes. The age-adjusted prevalence rates of ESRD for Wisconsin and the United States have been quite similar, with Wisconsin slightly higher, from 1978 through 1992. Beginning in the early 1990's, the Wisconsin rate increased more slowly than the overall United States rate. The trend has continued over the past ten years, and in 2002, the United States age-adjusted rate was 51.7 per 100,000 population, while the Wisconsin age-adjusted rate was 42.2 per 100,000 population. In general, the prevalence of ESRD has dramatically increased in the United States and Wisconsin over the past 25 years.<sup>23</sup>

Figure 44: Age-adjusted Prevalence Rate per 100,000 Population of End-stage Renal Disease with a Primary Diagnosis of Diabetes, 1978-2002. Source: United States Renal Data System



In Figure 45, the age-adjusted incidence rate of ESRD is shown for Wisconsin and the United States when the primary diagnosis is diabetes. During the period of 1978 to 1992, the United States and Wisconsin age-adjusted rates were quite similar. Again, in the early 1990's, the Wisconsin rate increased more slowly than the overall United States rate. In 2002, the United States age-adjusted incidence rate was 14.9 cases per 100,000 population, while the age-adjusted incidence rate for Wisconsin was 10.6 cases per 100,000 population. However, in general, the incidence of ESRD for the United States and Wisconsin has drastically increased during the past 25 years.<sup>23</sup>

Figure 45: Age-adjusted Incidence Rate per 100,000 Population of End-stage Renal Disease with a Primary Diagnosis of Diabetes, 1978-2002. Source: United States Renal Data System



# End-stage Renal Disease

Figure 46 provides age-specific prevalence rates of ESRD for Wisconsin when the primary diagnosis is diabetes. The highest rates are in the oldest age groups (ages 55-64 and ages 65 and above). The lowest prevalence rate of ESRD is seen in the youngest age group (0-34 years). The only age group where the prevalence of ESRD has remained stable over the past 25 years is the 0-34 age group. Prevalence rates have increased for all other age groups over the same period of time, though the 55-64 years and the 65 years and above age groups have increased at a faster rate.<sup>23</sup>

**Figure 46: Age-specific Wisconsin Prevalence Rate per 100,000 Population of End-stage Renal Disease with a Primary Diagnosis of Diabetes.** *Source: United States Renal Data System*

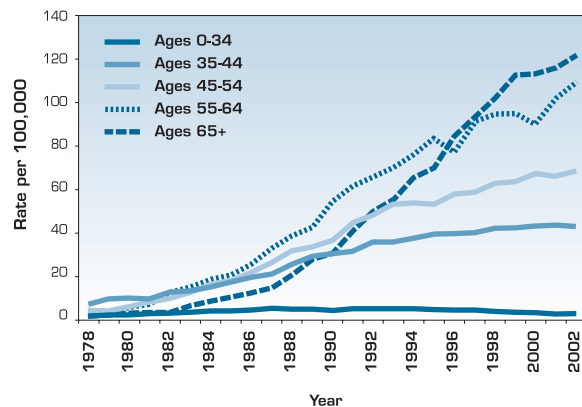
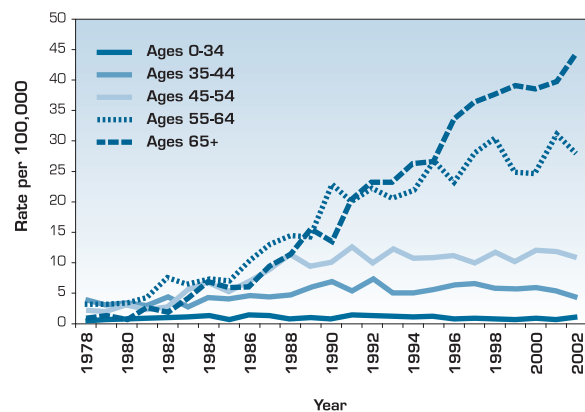


Figure 47 provides age-specific incidence rates of ESRD for Wisconsin when the primary diagnosis is diabetes. The highest rates are in the oldest age groups (ages 55-64 and ages 65 and above), while the lowest incidence rate of ESRD is seen in the youngest age group (0-34 years). Both the 0-34 age group and the 35-44 age group incidence rates have remained quite constant over time. The 45-54 year age group incidence rate increased from 1978 to 1990, but has leveled off in the 12 years. The remaining two age groups (the 55-64 and the 65 years and above) have increased significantly over the 25 year period.<sup>23</sup>

**Figure 47: Age-specific Wisconsin Incidence Rate per 100,000 Population of End-stage Renal Disease with a Primary Diagnosis of Diabetes.** *Source: United States Renal Data System*



# Diabetes Mortality

In 2003, diabetes was the sixth leading cause of death in Wisconsin, with 1,326 deaths occurring with diabetes listed as the underlying cause of death, often referred to as the “cause of death,” or the disease or injury initiating the sequence of events leading to death. The transition from International Classification of Diseases, Ninth Revision (ICD-9) to International Classification of Diseases, Tenth Revision (ICD-10) in 1999 has been taken into account in these data. A comparability ratio of 1.008167 (specifically for diabetes) was applied to all deaths before 1999, so that raw numbers from 1989-1998 can be compared accurately with numbers from 1999-2003.<sup>24</sup>

Figure 48 illustrates the raw number of deaths where diabetes was listed as the underlying cause of death.<sup>25</sup> These data are an underestimate of the number of diabetes-related deaths; in general, the number of deaths for which diabetes was a contributing cause of death is greater than the number when diabetes is listed as the underlying cause of death.<sup>24</sup> The American Diabetes Association states that more than 65% of people with diabetes die from heart disease or stroke.<sup>26</sup>

**Figure 48: Number of Deaths where Diabetes was Listed as the Underlying Cause of Death, Wisconsin Residents, 1989-2003.** *Source: Wisconsin Vital Records, 1989-2003. The diabetes comparability ratio was applied to years 1989-1998.*

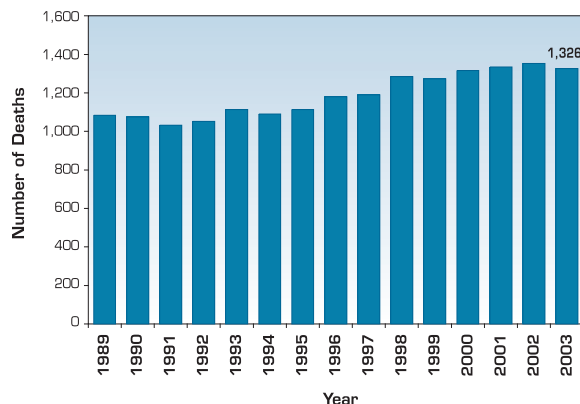
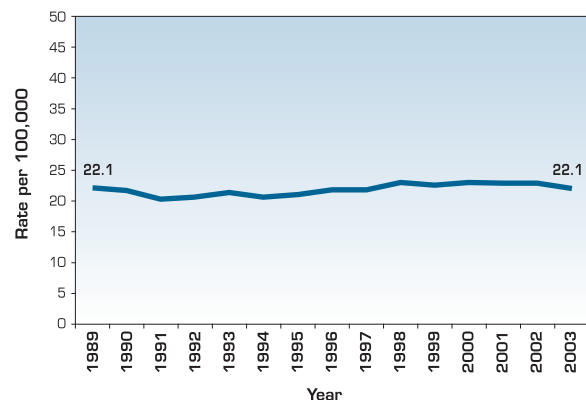


Figure 49 illustrates the age-adjusted mortality rate when diabetes is listed as the underlying cause of death from 1989-2003. The age-adjusted rate has varied little over this period and in 2003 the rate was 22.1 deaths per 100,000 population.<sup>25</sup> The transition from ICD-9 to ICD-10 in 1999 has been taken into account for this figure. A comparability ratio of 1.008167 was applied to all deaths before 1999, so that rates from 1989-1998 can be compared accurately with rates from 1999-2003.<sup>24</sup>

**Figure 49: Age-adjusted Mortality Rate per 100,000 Population for Deaths Where the Underlying Cause of Death was Diabetes, Wisconsin Residents, 1989-2003.** *Source: Wisconsin Vital Records, 1989-2003. The diabetes comparability ratio was applied to years 1989-1998.*





# Data Sources

## Behavioral Risk Factor Survey

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The Behavioral Risk Factor Survey (BRFS) is a random-digit-dial telephone survey administered to Wisconsin household members 18 years and older to assess the prevalence of risk behaviors and health practices that affect health status. The Wisconsin BRFS is part of the national Behavioral Risk Factor Surveillance System (BRFSS), which is organized by the United States Centers for Disease Control and Prevention. All 50 states and United States territories conduct the BRFS through their health departments. The Wisconsin BRFS is a representative statewide survey. Wisconsin began conducting the BRFS in 1984 and has carried it out each year since then. Adults living in nursing homes, dormitories, and other institutional settings are not included in the survey.<sup>6</sup>

The BRFS includes a core survey (which each state and U.S. territory is required to ask) and additional modules (which are optional and include more specific topics, such as HIV/AIDS, tobacco use, injury prevention, and diabetes).<sup>27</sup> One of the most important questions for diabetes surveillance in the core survey is “Have you ever been told by a doctor that you have diabetes?” This provides an estimate of the number of people in Wisconsin that have diabetes.

In 1995, Wisconsin began using the diabetes module, a set of questions asked of adults who answered “yes” to the core diabetes question “Have you ever been told by a doctor that you have diabetes?” Diabetes module questions allow collection of information on diabetes care that respondents are receiving, including foot exams, eye exams, A1C tests, and diabetes education. They also provide information on self-monitoring of blood glucose, insulin usage, diabetes medication usage, self-foot exams, and frequency of doctor’s visits. Many of the diabetes module questions have remained the same from 1995-2003, but some have been eliminated, some have changed, and others have been added. A minimum sample size of 100 was used in reporting all data.

Additional information on the United States Behavioral Risk Factor Surveillance System can be found at <http://www.cdc.gov/brfss/> and additional information on the Wisconsin BRFS can be found at <http://dhfs.wisconsin.gov/stats/BRFS.htm>.

## Wisconsin Family Health Survey

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The Wisconsin Family Health Survey (FHS) is a random-digit-dial telephone survey administered to Wisconsin household members of all ages to assess things such as health status, health problems, health insurance coverage, and use of health care services. The survey began in 1989 and has been conducted each year since that time. The FHS is a representative statewide survey. Adults living in nursing homes, dormitories, and other institutional settings are not included in the survey.<sup>10</sup>

The FHS provides the best estimate of the number of children and adolescents in Wisconsin who have diabetes, as the health information of every household member is inquired about during the survey.

Additional information on the Wisconsin Family Health Survey can be found at: <http://dhfs.wisconsin.gov/stats/familyhealthsurvey.htm>.

## National Health and Nutrition Examination Survey

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The National Health and Nutrition Examination Survey (NHANES) is a national population-based survey examining the health and nutrition of United States households. There are two parts to the survey: the home interview and the health examination. During the home interview, participants are asked about their health status, history, and diet. During the health examination, many tests are performed (e.g., hearing test, urine and blood tests), and a great deal of information is collected (e.g., body weight, blood pressure, body fat, physical activity). There are no invasive tests completed during the health examination.<sup>28</sup>

For the purposes of this surveillance report, NHANES information was used to determine an estimate of the number of adults aged 40-74 years with pre-diabetes in Wisconsin.



# Data Sources

## Inpatient Hospitalization Discharge Database

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Wisconsin hospitals are required to report selected Uniform Billing elements for all hospital inpatient discharges on a quarterly basis to the state under Chapter 153, Wis. Stats.<sup>29</sup> The reported records were received and edited by the Department of Health and Family Services, Bureau of Health Information and Policy for discharge dates through September 30, 2003. That responsibility was transferred under contract to the Wisconsin Hospital Association beginning with discharge dates from October 1, 2003. Wisconsin is one of the thirty-eight states involved in the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ). All states involved in HCUP are invited to submit their inpatient hospitalization data to be included in the Nationwide Inpatient Sample (NIS). The NIS database is designed to approximate a 20% sample of United States community hospitals. It should be noted that there may be years for which some states' data may not be part of NIS.<sup>30</sup>

## United States Renal Data System Renal Data Extraction and Referencing System

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Data in this report were obtained from the United States Renal Data System Renal Data Extraction and Referencing System. The United States Renal Data System (USRDS) provides an online tool to acquire data on end-stage renal disease (ESRD), referred to as the Renal Data Extraction and Referencing (RenDER) System.<sup>23</sup> The tool is web-based and allows the user to gather information on the prevalence and incidence of ESRD by indicating specifications he or she wishes to examine. Specifications include: year, gender, race, ethnicity, age, modality, primary diagnosis, hospital service area (HSA), county, state, and renal network. Data may be requested in a variety of forms, including: raw count, death count, raw percent, unadjusted rate of disease, unadjusted rate of death, unadjusted hospital days, unadjusted admission rate, and average biochemical levels (body mass index, estimated GFR, height, hemoglobin, initial BUN, initial UREA, creatinine clearance, serum albumin, serum albumin lower limit, serum creatinine, and weight). RenDER rapidly returns a table of data or an interactive map based upon the user's query specifications. Data is available in RenDER from 1978 to 2002.<sup>23</sup>

## Wisconsin Mortality Database

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Chapter 69.18 of the Wisconsin Statutes requires registration of every death taking place in Wisconsin.<sup>31</sup> Diabetes mortality information is from death certificates filed with the State Registrar, Vital Records Section, Bureau of Health Information and Policy (BHIP), Division of Public Health, Department of Health and Family Services.

# Methodology and Limitations

## Estimated Diabetes Prevalence in Adults (18 years and older)

**POPULATION** – Population figures used to calculate prevalence rates are 2002 population estimates from the data files found on the United States Census Bureau web site.<sup>8</sup> Population was first determined for each county for three age groups and six race/ethnicity groups, using the statistical software SAS®.<sup>32</sup> Information from the Census Bureau web site provided population estimates for ages 15-19 and 20-44 years for each county and race/ethnicity group, but did not provide specific data for the age group 18-44 years. Therefore, to determine an estimate of the number of people aged 18-44 years for the 2002 population estimates, the following steps were undertaken:

- 1) Access 2000 United States Census counts. Specifically look at the age groups 15-17 years and 18-19 years.
- 2) Add these two age groups for each county (72 counties) and for each race/ethnicity group (6 race/ethnicity groups).
- 3) Determine the proportion of 18-19 year olds in the 15-19 year old age group (using 2000 census data) for each county and each racial/ethnicity group.
- 4) Multiply the proportion of 18-19 year olds by the actual number of 15-19 year olds (using the 2002 population estimates) for each county and race/ethnicity group.
- 5) This number is an estimate of the number of persons 18-19 years old in 2002; add this to the 20-44 year old age group (for each county and racial/ethnic group) to get an estimate of the number of 18-44 year olds.

Population counts are rounded to the nearest ten, and rounded county totals were summed to determine the state population.

**AGE GROUPS** – Age groups utilized for diabetes prevalence in this report are: 18-44 years, 45-64 years, and 65+ years. Although American Indian and Alaska Native prevalence rates are for 15-44 years, the rates are applied to the appropriate population 18-44 years (see the *American Indian and Alaska Native Prevalence* section following).

**RACE AND ETHNICITY GROUPS** – The six race and ethnicity groups are: 1) Non-Hispanic African American, 2) Non-Hispanic American Indian and Alaska Native, 3) Non-Hispanic Asian American, 4) Hispanic/Latino, 5) Non-Hispanic Other Race/Multi-Race, and 6) Non-Hispanic White. Hispanic/Latino persons include those who are Hispanic/Latino of any race.

**ESTIMATED DIAGNOSED PREVALENCE** – Prevalence is the number of cases of a disease that are present in a population during a specified time. Estimated prevalence was determined for the age groups and race/ethnicity groups described above. The statistical software SAS was used to obtain all prevalence estimates, except for the American Indian/Alaska Native estimates, which were provided by Great Lakes Inter-Tribal Council, Inc.<sup>32</sup> Wisconsin-specific data were used when available; all other prevalence rates are based on regional or national estimates. There are limitations to these data due to survey sample size of certain racial/ethnic groups in Wisconsin. Age and race/ethnicity-specific rates were then applied to the applicable populations for each county (in order to ascertain numbers of adults with diagnosed diabetes for each age group and race/ethnicity group in each county). Numbers of adults with diagnosed diabetes in each county were rounded to the nearest ten, and age and race/ethnicity groups for each county were summed to determine the state total. Percents of estimated diagnosed adults were calculated by dividing the numbers of diagnosed adults by the appropriate population; percents were rounded to one decimal point. Included below is further information on the specific data sources for each of the racial/ethnic groups. It should be noted that different sources were used to obtain prevalence data, based on sample size constraints for certain racial/ethnic groups. However, an attempt was made to select similar data sources to provide consistency in data analysis.

### • *Non-Hispanic African American Prevalence*

Prevalence rates are from the Wisconsin Behavioral Risk Factor Survey (BRFS), 1999-2002. Specific Southeastern Region Non-Hispanic African American rates for 1999-2002 were applied to the appropriate populations in counties found in the Southeastern Region (Jefferson, Kenosha, Milwaukee, Ozaukee,

# Methodology and Limitations

Racine, Walworth, and Waukesha Counties), while state rates for 1999-2002 were applied to the appropriate populations for all other counties. State rates were used for all counties not in the Southeastern Region because sample sizes for these regions were not large enough to provide a reliable prevalence estimate for their appropriate counties. Application of these rates allowed determination of an estimated number of Non-Hispanic African Americans diagnosed with diabetes in each of the three age groups for each county.

- *Non-Hispanic American Indian and Alaska Native Prevalence*

Prevalence rates are 2003 rates from Great Lakes Inter-Tribal Council, Inc. (GLITC). Prevalence rates were applied to the appropriate population in each county to determine an estimated number of Non-Hispanic American Indian and Alaska Native adults diagnosed with diabetes in each of the three age groups for each county. Specific rates for the 18-44 year age group were not available for the American Indian and Alaska Native population; the rate for the 15-44 year age group was applied to the appropriate populations 18-44 years of age.

- *Non-Hispanic Asian, Native Hawaiian, and Other Pacific Islander Prevalence*

Prevalence rates for Non-Hispanic Asian, Native Hawaiian, and Other Pacific Islanders in the age groups 18-44 years and 45-64 years were obtained from the 1999-2002 Behavioral Risk Factor Survey (BRFS) from the following states: Wisconsin, Illinois, Iowa, Michigan, and Minnesota. The reason for the use of multiple states is because the sample size for Wisconsin was not large enough to provide an accurate prevalence estimate. The prevalence rate for the 65 years and older age group was obtained from the 1999-2002 BRFS for the entire United States (except Alaska and Hawaii). Again, the reason for using multiple states is due to the sample size being too small for Wisconsin. Adding the surrounding states to Wisconsin did not provide a large enough sample for this older age group. These rates were applied to the appropriate populations in each county to determine an estimated number of Non-Hispanic Asian,

Native Hawaiian, and Other Pacific Islanders diagnosed with diabetes in each of the three age groups for each county.

- *Hispanic/Latino Prevalence*

Prevalence rates for Hispanics/Latinos in the age groups 18-44 years and 45-64 years were obtained from the 1999-2002 Wisconsin BRFS. Prevalence rates for Hispanics/Latinos in the age group 65 years and above were obtained from the 1999-2002 BRFS from the following states: Wisconsin, Illinois, Iowa, Michigan, and Minnesota. The reason for the use of multiple states for the 65 years and older age group is because the sample size for Wisconsin was not large enough to provide an accurate prevalence estimate for this age group. Rates were applied to the appropriate population in each county to determine an estimated number of Hispanic/Latino adults diagnosed with diabetes in each of the three age groups for each county.

- *Non-Hispanic Some Other Race and Multi-Race*

It is estimated that approximately 24,600 adults in Wisconsin 18 years and above are “Non-Hispanic Some Other Race” or “Non-Hispanic Multi-Race.” Prevalence rates for Non-Hispanic Some Other Race and Non-Hispanic Multi-Race for all age groups were obtained from the 1999-2002 Behavioral Risk Factor Survey (BRFS) from the following states: Wisconsin, Illinois, Iowa, Michigan, and Minnesota. The reason for the use of multiple states is because the sample size for Wisconsin was not large enough to provide an accurate prevalence estimate. These rates were applied to the appropriate population in each county to determine an estimated number of Non-Hispanic Some Other Race or Non-Hispanic Multi-Race adults diagnosed with diabetes in each of the three age groups for each county.

- *Non-Hispanic White*

Prevalence rates for Non-Hispanic Whites are from the Wisconsin BRFS, 1999-2002. Rates for the three age groups within each of the five Department of Health and Family Services regions were determined. These region-specific rates were applied to the appropriate county's population (except for Dane, Milwaukee, and Waukesha Counties) to determine an estimated

# Methodology and Limitations

number of Non-Hispanic Whites diagnosed with diabetes in each of the three age groups for each county (except those noted earlier). County-specific rates for Non-Hispanic Whites were applied to the appropriate population in Dane, Milwaukee, and Waukesha Counties to determine the estimated number of Non-Hispanic White adults in each of these counties diagnosed with diabetes in each of the three age groups. The map on page 41 displays counties and their corresponding regions.

**UNDIAGNOSED PREVALENCE** – In the United States, an estimated 13.0 million persons have been diagnosed with diabetes, and 5.2 million persons have diabetes that has not been diagnosed.<sup>5</sup> This ratio of undiagnosed to diagnosed (5.2 million:13.0 million or 40.0%) was used in determining the estimated number of adults in Wisconsin who have undiagnosed diabetes. Unrounded numbers of diagnosed adults were multiplied by the above ratio to determine the estimated number of adults who have undiagnosed diabetes in each age group and racial/ethnic group for each county. Rounded county estimates were summed to determine state estimates for the three age groups for each race/ethnicity and all races/ethnicities combined. Percents of estimated undiagnosed adults were calculated by dividing the numbers of undiagnosed adults by the appropriate populations; percents were rounded to one decimal point.

**TOTAL PREVALENCE** – County-specific rounded numbers of diagnosed adults and rounded numbers of undiagnosed adults were summed for each of the three age groups to determine the total estimated number of adults with diabetes by county. This same process is completed to determine the total prevalence for each racial/ethnic group. Rounded estimates are summed to determine state estimates. Percents of estimated totals are calculated by dividing the numbers of total adults by the appropriate populations; percents are rounded to one decimal point. In some cases, the total percents may not equal the sum of diagnosed percents and undiagnosed percents, due to rounding.

## Estimated Diabetes Prevalence in Adults by Race/Ethnicity

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**AGE-SPECIFIC ESTIMATED DIABETES PREVALENCE BY RACE/ETHNICITY** – County estimates in each of the three age groups for each race/ethnicity group were summed to determine a state-wide estimate of the number of adults with diabetes in each of the six racial/ethnic groups for each of the three age groups.

**AGE-ADJUSTED ESTIMATED DIABETES PREVALENCE RATES BY RACE/ETHNICITY** – Differences in population distribution can lead to misleading overall prevalence estimates (especially for different racial/ethnic groups, some of which have very different population distributions). For example, 77.4% of the adult Hispanic/Latino population is aged 18-44 years, compared to 49.2% of the Non-Hispanic White population. Due to this difference in age distribution and the fact that the prevalence of diabetes is lower for younger age groups, the prevalence estimate for the “All ages” group for the Hispanic/Latino population would be an underestimate if it were presented in raw percent format. Age-adjustment allows us to remove differences in rates between groups, while controlling for differences in the age variations of the populations. Overall (all ages 18 years and older) prevalence estimates for all racial/ethnic groups were age-adjusted and presented in rates per 100,000 population for diagnosed, undiagnosed, and total estimates (Table 8). County prevalence estimates were age-adjusted for the map in Figure 3.

## Estimated Diabetes Prevalence in Children and Adolescents (17 years and younger)

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**POPULATION** – Population figures are 2003 population estimates from Wisconsin Interactive Statistics on Health (WISH).<sup>33</sup>

**ESTIMATED DIAGNOSED PREVALENCE** – Prevalence is the number of cases of a disease that are present in a population during a specified time. Prevalence rates were obtained for the age groups 0-9 and 10-17 years from the Wisconsin Family Health Survey 2000-2003.<sup>11</sup> The Department of Health and Family Services, Division of Public Health, Bureau of Health Information and Policy provided the estimates for this report.

# Methodology and Limitations

## Estimated Pre-diabetes Prevalence in Adults (ages 40-74 years)

The Centers for Disease Control and Prevention 2003 National Diabetes Fact Sheet states that 40.1% of adults aged 40-74 years have pre-diabetes.<sup>7</sup> These findings are from the 1988-1994 National Health and Nutrition Examination Survey.

Population figures are 2002 Wisconsin population estimates from the data files found on the United States Census Bureau web site.<sup>8</sup> Population was determined for each racial/ethnic group for ages 40-74 years. Each racial/ethnic group's population aged 40-74 years was multiplied by 0.401 to determine an estimate of the number of adults aged 40-74 years with pre-diabetes. All racial/ethnic groups were summed to determine a statewide estimate of the number of people aged 40-74 with pre-diabetes.

## Economic Costs of Diabetes

The American Diabetes Association published an article in the March 2003 edition of *Diabetes Care*, entitled "Economic Costs of Diabetes in the U.S. in 2002." Per capita figures in this report were obtained from this article and extrapolated to the estimated population with diabetes in Wisconsin to determine the estimated costs of diabetes in Wisconsin. The article found that the per capita cost of medical expenditures for a person with diabetes was \$13,243.<sup>4</sup> Though the article also presented a separate adjusted figure, based on differences in age, sex, and race/ethnicity, the figure of \$13,243 was used for this report. Diabetes affects older populations and certain races/ethnicities more often. If the adjusted amount had been used, this would have assumed the average age of the person with diabetes was identical to the average age of the person without diabetes, which is not the case.

The article found that 69.77% of the total costs of diabetes were direct medical expenditures, while the remaining 30.23% were indirect costs due to lost productivity. This led to the per capita estimate of \$5,738 for indirect costs due to lost productivity.<sup>4</sup> The following simple algebraic equation shows how this figure was obtained.

$$\begin{aligned}\frac{0.3023}{0.6977} &= \frac{x}{\$13,243} \\ (0.6977)(x) &= (0.3023)(\$13,243) \\ 0.6977x &= \$4,003.3589 \\ x &= \$5,737.94 \\ x &= \$5,738\end{aligned}$$

Direct medical expenditures for adults were calculated by multiplying the estimated number of adults with diagnosed diabetes in Wisconsin (235,330) by \$13,243, totaling \$3,116,475,190. Indirect costs due to lost productivity for adults were calculated by multiplying the estimated number of adults with diagnosed diabetes in Wisconsin (235,330) by \$5,738, totaling \$1,350,323,540. Direct medical expenditures for children and adolescents were calculated by multiplying the estimated number of children/adolescents with diagnosed diabetes in Wisconsin (4,000) by \$13,243, totaling \$52,972,000. For this analysis, an estimate of indirect costs for children/adolescents is not included, as children/adolescents are generally not members of the workforce (there are some exceptions). The summation of all of these costs totals an estimated \$4.52 billion. It must be noted that this estimate only includes persons diagnosed with diabetes. Persons with diabetes that is undiagnosed arguably don't incur the same costs as those diagnosed with diabetes; however, the figure of \$4.52 billion is likely an underestimate, as it considers none of the direct or indirect costs for persons with undiagnosed diabetes. Furthermore, the figure does not include persons with pre-diabetes.

## Sociodemographics

Data are from the 2002-2003 Wisconsin Behavioral Risk Factor Survey. Two years of data are used to provide more accurate and reliable estimates. All percentages are weighted and representative of the entire state of Wisconsin. Missing values, refusals, and responses of "don't know" are not included in the denominator for that particular question. The statistical software SAS was used to analyze all data.<sup>32</sup>



# Methodology and Limitations

## Risk Factors

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Data are from the 2002-2003 Wisconsin Behavioral Risk Factor Survey. Two years of data are used to provide more accurate and reliable estimates. In some cases, only one year of data was available for some of the measures, due to the question not being asked during a particular year. All percentages are weighted and representative of the entire state of Wisconsin. Missing values, refusals, and responses of “don’t know” are not included in the denominator for that particular question. The statistical software SAS was used to analyze all data.<sup>32</sup>

## Self-reported General Health

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Data are from the 2002-2003 Wisconsin Behavioral Risk Factor Survey. Two years of data are used to provide more accurate and reliable estimates. All percentages are weighted and representative of the entire state of Wisconsin. Missing values, refusals, and responses of “don’t know” are not included in the denominator for that particular question. The statistical software SAS was used to analyze all data.<sup>32</sup>

## Current Status of Diabetes

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Data are from the 2002-2003 Wisconsin Behavioral Risk Factor Survey. Two years of data are used to provide more accurate and reliable estimates. All percentages are weighted and representative of the entire state of Wisconsin. Missing values, refusals, and responses of “don’t know” are not included in the denominator for that particular question. The statistical software SAS was used to analyze all data.<sup>32</sup> Healthy People 2010 goals were obtained from the Healthy People 2010 web site.<sup>17</sup>

## Trends in Diabetes Care

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Data are from the 1995-2002 Wisconsin Behavioral Risk Factor Survey. Two years of data are used for each data point to provide more accurate and reliable estimates. In some cases, only one year of data was available for some measures (e.g., influenza vaccination), due to the question not being asked during a particular year. For some measures, diabetes module questions have been changed, deleted, or added over time; in effect, some measures do not have data available for all years. All percentages are

weighted and representative of the entire state of Wisconsin. Missing values, refusals, and responses of “don’t know” are not included in the denominator for that particular question. The statistical software SAS was used to analyze all data.<sup>32</sup>

## Trends in Selected Characteristics of Adults with Diabetes

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Data are from the 1995-2002 Wisconsin Behavioral Risk Factor Survey. Two years of data are used for each data point to provide more accurate and reliable estimates. In some cases, only one year of data was available for some measures (e.g., blood pressure), due to the question not being asked during a particular year. All percentages are weighted and representative of the entire state of Wisconsin. Missing values, refusals, and responses of “don’t know” are not included in the denominator for that particular question. The statistical software SAS was used to analyze all data.<sup>32</sup>

## Diabetes-related Inpatient Hospitalizations

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All data are from the Wisconsin Inpatient Hospitalization Discharge Database. Data on diabetes-related inpatient hospitalizations include all ages (children and adults), but do not include hospitalizations at any Veteran’s Administration (VA) hospitals, which are exempt from state reporting requirements. Hospitalizations for non-Wisconsin residents and for Wisconsin residents hospitalized outside of Wisconsin are not included.

For this report, when diabetes is listed as the principal diagnosis, the reporting of an ICD-9 code 250.0 – 250.93 is found in the data element “Principal Diagnosis.” When diabetes is listed as any diagnosis, the reporting of an ICD-9 code 250.0 – 250.93 is found in the “Principal Diagnosis” data element or any of the “Other Diagnosis” data elements. Those hospitalizations that report more than one diabetes code for one hospitalization are only counted once.

Raw numbers of hospitalizations for age groups 0-24 years, 25-44 years, 45-54 years, 55-64 years, 65-74, 75-84 years, and 85+ years were obtained using the statistical software SAS.<sup>32</sup> Population estimates (and counts for census years) were obtained from

# Methodology and Limitations

the Department of Health and Family Services, Division of Public Health, Bureau of Health Information and Policy. Raw numbers of diabetes-related hospitalizations were divided by applicable population estimates/counts to determine age-specific rates. Age-specific rates were age-adjusted (direct-method) to the 2000 United States standard population.

Data from inpatient hospitalization discharges is recorded on the Uniform Health Insurance Claim (UB-92) form. Prior to the fourth quarter of 1993, Wisconsin collected the following data elements related to diagnoses listed upon discharge:

- Principal Diagnosis
- Other Diagnosis 1
- Other Diagnosis 2
- Other Diagnosis 3
- Other Diagnosis 4

Beginning with the fourth quarter of 1993, Wisconsin started collecting four **additional** data elements to assess diagnoses, including:

- Other Diagnosis 5
- Other Diagnosis 6
- Other Diagnosis 7
- Other Diagnosis 8

The addition of the collection of these four data elements may have led to increases in the numbers of persons with a discharge when diabetes was any diagnosis in 1994 and subsequent years. Data examining diabetes-related hospitalizations are only presented for years 1994 and after, to allow for comparison of consistent data during the time period.

## Diabetes-related Lower-extremity Amputations

All data are from the Wisconsin Inpatient Hospitalization Discharge Database. Data on diabetes-related lower-extremity amputations include all ages, but do not include amputations at any Veteran's Administration (VA) hospitals, which are exempt from state reporting requirements. Lower-extremity amputations for non-Wisconsin residents and for Wisconsin residents hospitalized outside of Wisconsin are not included.

For this report, a diabetes-related lower-extremity amputation is defined as a non-traumatic lower-extremity amputation (ICD-9 code 84.1 – 84.19) listed as the principal procedure or as any other procedure when diabetes (ICD-9 code 250.0 – 250.93) is listed as the principal diagnosis or as any other diagnosis. Those hospitalizations that report more than one amputation code or more than one diabetes code for one hospitalization are only counted once.

Raw numbers of amputations for age groups 0-64 years, 65-74 years, 75+ years were obtained using the statistical software SAS.<sup>32</sup> Population estimates (and counts for census years) were obtained from the Department of Health and Family Services, Division of Public Health, Bureau of Health Information and Policy. Diabetes-related lower-extremity amputation rates were age-adjusted (direct method) to the 2000 United States standard population.

As explained earlier, data from inpatient hospitalization discharges is recorded on the Uniform Health Insurance Claim (UB-92) form. Prior to the fourth quarter of 1993, Wisconsin collected the following data elements related to procedures performed during a hospital stay:

- Principal Procedure
- Other Procedure 1
- Other Procedure 2

Beginning with the fourth quarter of 1993, Wisconsin started collecting three **additional** data elements related to procedures, including:

- Other Procedure 3
- Other Procedure 4
- Other Procedure 5

The addition of the collection of these three data elements (and the additional four data elements related to diagnoses) may have led to increases in the numbers of persons with a discharge when a non-traumatic lower-extremity amputation was listed as any procedure and diabetes was any diagnosis. Data examining diabetes-related amputations are only presented for years 1994 and after, to allow for comparison of consistent data during the time period.

# Methodology and Limitations

## End-stage Renal Disease

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The United States Renal Data System Renal Data Extraction and Referencing (RenDER) System online tool was used to obtain raw numbers of prevalence and incidence of end-stage renal disease for age groups 0-34 years, 35-44 years, 45-54 years, 55-64 years, and 65+ years in persons with diabetes listed as the primary diagnosis.<sup>23</sup> Data were obtained for each year from 1978 to 2002. All races/ethnicities, all modalities of treatment, and both genders were included in the analyses. Population estimates (and counts for census years) were obtained from the United States Census Bureau web site, as well as the Department of Health and Family Services, Division of Public Health, Bureau of Health Information and Policy. Raw numbers were divided by applicable population estimates/counts to determine age-specific rates. Age-specific rates were age-adjusted (direct method) to the 2000 United States standard population.

## Diabetes Mortality

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Raw numbers of deaths where diabetes was listed as the underlying cause of death were obtained from the Wisconsin mortality database, using the statistical software SAS.<sup>32</sup> Deaths were determined for age groups 0-44 years, 45-54 years, 55-64 years, and 65-74 years, 75-84 years, and 85+ years. All races/ethnicities and both genders were included in the analyses. Population estimates (and counts for census years) were obtained from the Department of Health and Family Services, Division of Public Health, Bureau of Health Information and Policy. Raw numbers were divided by appropriate population estimates/counts to determine age-specific rates. Age-specific rates were age-adjusted (direct method) to the 2000 United States standard population.

It should be noted that the use of “underlying cause of death” is likely an underestimate of the number of diabetes-related deaths, as diabetes often contributes to a death for which another disease/condition is listed as the underlying cause of death.

Prior to 1999, International Classification of Diseases, Ninth Revision (ICD-9) codes were used to code deaths; diabetes ICD-9 codes are 250.0 – 250.93. Beginning in 1999, causes of death were coded using the International Classification of Diseases, Tenth Revision (ICD-10); diabetes ICD-10 codes are E10 – E14. Because the change from ICD-9 to ICD-10 can affect coding and classification, a comparability ratio allows one to compare deaths prior to 1999 (using ICD-9 codes) to deaths in 1999 and thereafter (using ICD-10 codes). The comparability ratio for diabetes is 1.008167; this means that for every one death in 1999 (or later years) due to diabetes, 1.008167 deaths were coded listing diabetes in years prior to 1999. In this report, the comparability ratio was used to allow for comparison of data over the 1989-2003 time period.



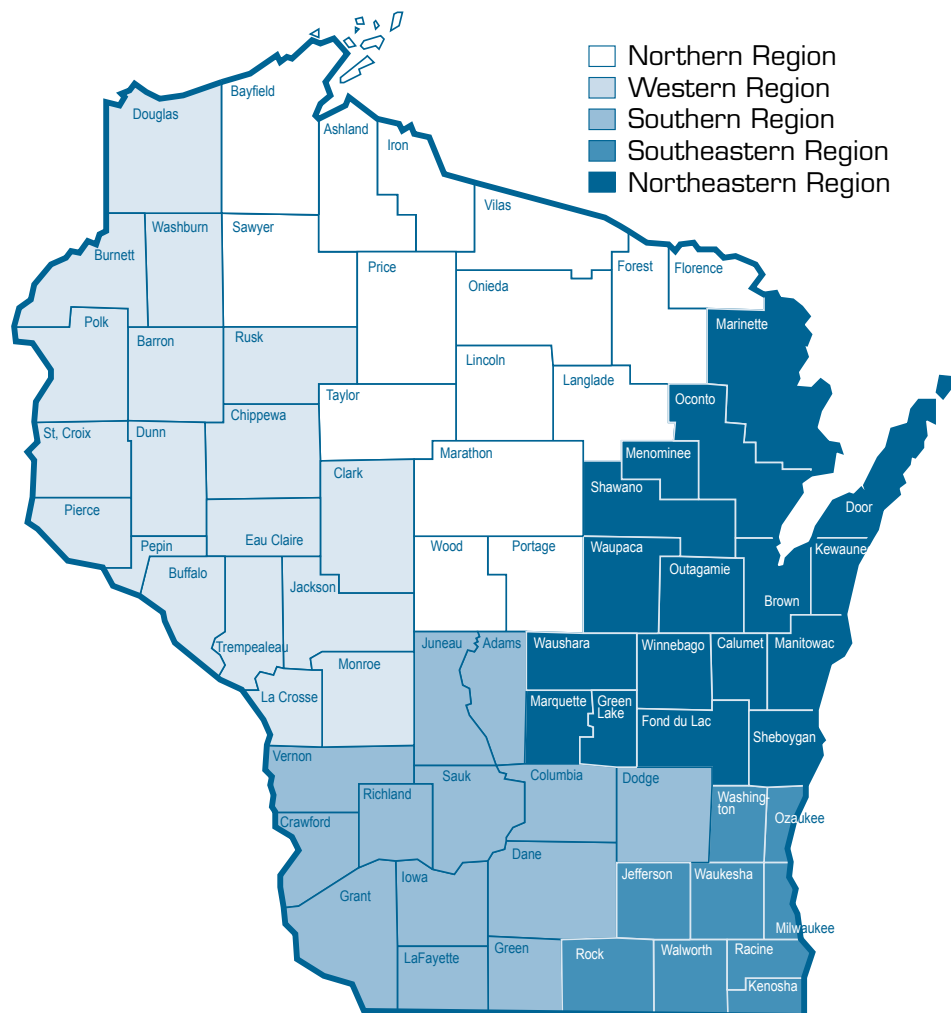


Figure 50: Wisconsin Map of Department of Health and Family Services Regions

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THE DIABETES PREVENTION AND CONTROL PROGRAM GRATEFULLY ACKNOWLEDGES  
THE TIME AND EXPERTISE OF THE FOLLOWING PEOPLE:

Melissa Meredith, MD, University of Wisconsin Hospital and Clinics  
Karl Pearson, MS, Bureau of Workforce Information, Division of Workforce Solutions,  
Wisconsin Department of Workforce Development  
Kelly Stolzmann, BS, University of Wisconsin Population Health Institute  
Pat Zapp, Formerly of the Diabetes Prevention and Control Program

AND THE FOLLOWING INDIVIDUALS FROM  
THE WISCONSIN DEPARTMENT OF HEALTH AND FAMILY SERVICES, DIVISION OF PUBLIC HEALTH:

Jenny Camponeschi, MS, Randall L. Glysch, MS, Leah Ludlum, RN, BSN, CDE,  
Jennifer C. Ullsvik, MS, Mark V. Wegner, MD, MPH, Judy Wing, and  
Herng-Leh (Mike) Yuan, MPH of the Bureau of Community Health Promotion  
Angela Nimsgern, MPH, of the Bureau of Local Health Support and Emergency Medical Services,  
Northern Region and Tim Ringhand, RN, MPH,  
Bureau of Local Health Support and Emergency Medical Services, Western Region  
Richard E. Miller, MS, Audrey Nohel, and Stephanie Ward of the  
Bureau of Health Information and Policy